

THE EFFECTS OF PHYSICAL AND MENTAL FOCI  
ON SELF-REGULATORY PERSISTENCE

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Given the tendency for humans to dichotomize phenomena into mental and physical categories, the present work explored the consequences of this dichotomization within the domain of self-control exertion. In particular, these studies develop an individual difference of mental-physical interactionism, manipulate situational features promoting a focus on mental or physical phenomena, and examine how these factors influence perceptual, cognitive, and behavioral responding in self-control contexts. Results show that these factors show independent and interactive effects on metrics of task construal, subjective pain, and overall self-control exertion. Such findings warrant future inquiry on the role of metaphysical representations within the domain of self-control, as well as within other domains of psychological and physiological science.

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## The Effects of Physical and Mental Foci on Self-Regulatory Persistence

*“Nature also teaches me by these sensations of pain, hunger, thirst, etc. that I am not only lodged in my body as a pilot in a vessel, but that I am very closely united to it, and so to speak so intermingled with it that I seem to compose with it one whole.”*

(René Descartes, Meditation VI)

In his classic work on *mind-body dualism*, Descartes ponders the distinction between mental and physical experience. Although his work has been interpreted in various fashions over the past centuries, his core contribution to philosophy concerns the extent to which our inner, conscious experience is fundamentally separate from the forces of the physical world (Descartes, 1641). Some philosophers have argued for various essences of *dualism*, asserting that mental and physical experiences rely on the operation of fundamentally different properties, substances, or divinities; others have argued for various essences of *physicalism*, asserting that all experience can be understood as the functioning of principal physical forces (Churchland, 2013; Crane & Patterson, 2012; Fodor, 1981; Megill, 2007).

As a precursor to the present work, I review the state of human understanding surrounding the question of mind-body dualism from the perspective of psychological science. I argue that although dualism has become decreasingly viable from an empirical viewpoint, it continues to influence human thought through societal and individual factors that promote the dichotomization of physical and mental experience. Following from this review, I reason that individuals are prone to differentiate between the mental or physical components of various stimuli, and propose that this differentiation is contingent upon particular situational and individual features. Finally, I present a series of



studies concerned with understanding how these features independently and interactively influence participant responding within self-control contexts.

### **A Physicalist's Perspective**

In the modern era of scientific thought, there appears to be little debate on the question of mind-body dualism. Indeed, whether one considers scientific thinking as a whole (Larson & Witham, 1998) or within particular academic disciplines (Clark, 2010; Farah & Murphy, 2009), distinguishing between mental and physical systems is no longer fundamental (for dissenting views, see Klein, 2012; Levine, 1983; Megill, 2007; Miller, 2010; Rakover, 2011). Instead, scientists have begun exploring the interrelation between myriad human systems, and their inquiry has resulted in an explosion of theoretical perspectives on the interrelation between mind and body. Although such perspectives vary in their ultimate philosophical and practical conclusions, each offers evidence suggesting that mental processes are but one aspect of a larger physical universe.

The domain of psychological science offers numerous instances of mental constructs being activated, influenced, and ultimately contingent upon, concrete biological systems. One prominent example is the burgeoning literature on *cognitive neuroscience* (Cacioppo, Berntson, Ernst, & Ito, 2000; Lieberman, 2007; Ochsner & Lieberman, 2001). In simple terms, this literature operates under the assumption that subjective experiences and human decisions are grounded within higher-level cognitive networks, which are further grounded within complex biological systems in the central nervous system. Thus, the brain is posited as the primary mechanism by which mental experience arises, and the mind is thus explained via concrete - albeit incredibly complex - physiological processes. Another prominent example of the mind's physiological basis

is found among research on *embodied cognition* (Niedenthal et al., 2005). Work in this domain suggests that mental responses are influenced by the activation of various physiological systems, such that cartoons are deemed more humorous when one is smiling (Strack, Martin, & Stepper, 1988), issues are thought to be more important when one is holding a heavy weight (Jostmann, Lakens, & Schubert, 2009), and the self is perceived as more powerful when one adopts an expansive posture (Carney, Cuddy, & Yap, 2010). Examined from the perspective of mind-body dualism, these findings again imply that mental experience is influenced by phenomena situated within the observable physical universe (Clark, 2010).

Both neuroscientific and embodied cognitive perspectives suggest that the most parsimonious explanation for subjective experience involves convergence, rather than divergence, between physical and mental systems. However, even if we ignore these overarching literatures, there exist numerous other examples of mental-physical convergence within contemporary psychological science. One such example concerns inquiry into human pain perception. In particular, recent work suggests that the distinction between physical pain (i.e., pain elicited by endogenous physical stimulation) and social pain (i.e., pain elicited by negative social information) is quite small. For one, experiencing pain within one domain increases pain sensitivity within the opposite domain, such that being socially ostracized increases negative physiological reactions to aversive environmental stimuli, just as being exposed to aversive environmental stimuli increases emotional reactions to aversive social information (Brown, Sheffield, Leary, & Robinson, 2003; MacDonald, Kingsbury, & Shaw, 2005; but see Bernstein & Claypool, 2012). In a similar vein, social ostracism produces subjective experiences that mimic

acute physiological pain (Eisenberger, Lieberman, & Williams, 2003), just as social support reduces subsequent feelings of physiological pain (Hoogendoorn, van Poppel, Bongers, Koes, & Bouter, 2000). Finally, consuming pain-reducing medication (e.g., Tylenol) is shown to lessen the subjective (DeWall et al., 2010), behavioral (Randles, Heine, & Santos, 2013), and neurological (DeWall et al., 2010) impact of social rejection; effects that are conventionally observed when consuming these medications for physical ailments. To explain this larger pattern of findings, theorists argue that social and physical pain rely on shared biological and neurophysiological processes - particularly those in the central nervous system (Eisenberger & Lieberman, 2004; 2005; MacDonald & Leary, 2005; Price, 2000) - such that subjective pain represents a domain-general physiological reaction to various types of negative stimuli.

In addition to work on the overlap between physical and mental pain, research suggests that there is an analogous overlap between mental and physical fatigue. In particular, many social-psychologists have posited that human self-control is reliant upon the availability of bodily resources, such that the mental capability to resist temptation and/or mobilize effective goal pursuit is constrained by the energy limitations of particular biological processes (for a review, see Baumeister, Vohs, & Tice, 2007). Although the validity of this theoretical perspective has been contested in more recent work (Hagger & Chatzisarantis, 2013; Inzlicht & Schmeichel, 2012; Inzlicht, Schmeichel, & Macrea, 2013; Kurzban, 2010; Kurzban, Duckworth, Kable, & Myers, 2013; Molden et al., 2012; Sanders, Shirk, Burgin, & Martin, 2012), empirical findings nonetheless suggest that self-control interacts with human physiological outcomes in various manners. For one, the initial exertion of self-control influences subsequent

performance on both predominantly physical (muscle exertion, Egan, Karpen, & Hirt, 2012; pain persistence, Schmeichel & Vohs, 2009) and predominantly mental (executive functioning, Schmeichel, 2007; intelligent responding, Schmeichel, Vohs, & Baumeister, 2003) domains. Additionally, the physiological ingestion of glucose has been shown to increase subsequent self-control performance, irrespective of whether this performance is ostensibly physical or mental in nature (Gailliot & Baumeister, 2007; Gailliot et al., 2007; see also Sripada, Kessler, & Jonides, 2014). Finally, initial effort exertion appears to alter physiological responding during subsequent self-control tasks, such that “depleted” individuals show dampened neurological responses in brain regions associated with cognitive control (Inzlicht & Gutsell, 2007; Wagner et al., 2013; Wagner & Heatherton, 2013), as well as dampened muscular activation in bodily regions associated with muscular control (Bray, Ginis, & Woodgate, 2011; Bray, Graham, Martin-Ginis, & Hicks, 2012). Together, the above findings suggest that exerting conscious control over one’s behavioral responses implicates both body and brain, such that individuals are objectively fatigued by effortful mental activity (for related findings, see Ackerman, 2011).

Regardless of whether one considers broad theoretical frameworks of psychological science (e.g., cognitive neuroscience, embodied cognition) or constrained theoretical frameworks of particular psychological phenomena (e.g., pain perception, self-control), the works reviewed in the present section suggest that a strict literal interpretation of mind-body dualism is wholly unsupported by modern scientific research (Gervais & Norenzayan, 2012; Larson & Witham, 1998; but see Demertzi et al., 2009). Although physicalism may leave humans with a less intuitive or less satisfying

perspective towards human experience (see below), this perspective offers the most parsimonious and empirically-validated explanation for how our subjective experiences are situated within the larger physical universe.

### **A Dualist's Perspective**

The above section argues that mind-body dualism is unsupported by modern science. However, as academic researchers are well aware, human populations are capable of remaining oblivious, ambivalent, or even contentious to scientific consensus on topics of particular philosophical and/or practical import (e.g., climate change, Scruggs & Benegal, 2012; evolution, Pew Research Center, 2013; see also Lewandowsky, Oberauer, & Gignac, 2013). In the section below, I outline several reasons why mind-body dualism remains a viable alternative to physicalism among numerous human populations. In particular, I argue that many societal structures directly or indirectly instantiate dualistic thinking in the modern world. Although an exhaustive list of these structures is beyond the scope of the present work, my examples reinforce the notion that dualistic thinking is commonplace in lay conceptions of human experience.

For one, with its prominence in most civilized societies (but see Larson & Witham, 1998), religion exerts a powerful influence on the perceived distinctiveness of mental and physical experience. Numerous religions propose the existence of an immaterial essence (e.g., soul, spirit, karma) that operates outside the influence of the physical world. Whether one considers Christian, Jewish, Buddhist, Muslim, or other categories of religious thought, these essences of spiritual transcendence are not subjected to the same physical laws that other stimuli are constrained within. Although there are certainly great variations in how such essences are conceptualized (Boyer, 2001), their

ubiquitous nature reinforces the notion that human experience extends beyond the operation of a primary physical universe (Bloom, 2007). Not surprisingly then, researchers studying individual differences in dualistic beliefs have found that dualism correlates moderately with religiosity (Preston, Ritter, & Hepler, 2013; Stanovich, 1985), with fervent religious believers often showing the most substantial levels of mind-body differentiation.

Another institutional force that reinforces dualistic thinking is modern healthcare. Clearly the understanding of health and disease varies greatly as a function of context, yet most first-world societies intrinsically and/or extrinsically endorse the distinction between physical and mental disorder. Indeed, many such societies contain separate institutions that champion medical and psychological models of healthcare, such that humans are exposed to the diagnosis and treatment of their ailments via distinct physical and mental methods (Freedland, Miller, & Sheps, 2006). Not surprisingly, this dichotomization leads doctors to rely on a spectrum of methods to treat otherwise identical human ailments. For instance, psychiatrists whose specialties vary along a mental-to-physical continuum have utilized treatments ranging from psychoanalysis (Freud, 1910) and positive encouragement (Rogers, 1965), to frontal lobotomies (Pressman, 1998), seizure induction (White, Shea, & Jonas, 1968), and psychopharmaceuticals (Leucht et al., 2012) in order to alleviate identical symptoms in human populations. Although these distinct methods of healthcare interact at various levels of operation (see Lane & Wager, 2009; Park, 2013; Suls, Luger, & Martin, 2010), the perceived division between physical and mental disorder reinforces dualistic beliefs within both patients and practitioners of modern healthcare.

## **The Dominant Perspective**

In the above sections, I have described scientific inertia towards tenets of physicalism, as well as institutional inertia towards tenets of dualism. In other words, many human populations are exposed to evidence both for and against the tenets of mind-body dualism. From this observation, the question arises as to whether humans are - on the whole - more likely to prescribe to physicalistic or dualistic interpretations of the natural world. On one hand, it could be expected that educated populations will readily endorse physicalism, simply because it corresponds to our current understanding of the overlap between mental and physical experience. On the other hand, it could be expected that these same populations, given their immersion within institutions that promote dualistic thinking, will readily endorse mind-body dualism. Although the present work does not offer a definitive resolution to these contrasting predictions, evidence appears to show that dualism - in comparison to physicalism - is the dominant metaphysical perspective.

The most direct evidence for this conclusion concerns recent research on the prevalence of dualistic thinking in various human populations. For one, work in developmental psychology indicates that children are “natural born theists” who support the perceived separation of physical and non-physical phenomena from a very early age (Bloom, 2004; Johnson, 1990; Kelemen, 2004; Legare, Evans, Rosengren, & Harris, 2012). As such, young humans understand brains (Gottfried, Gelman, & Schultz, 1999), death (Bering & Bjorklund, 2004), and even cloning (Hood, Gjersoe, & Bloom, 2012) in ways that distinguish between physical entities and their internal mental states. Furthermore, cross-cultural research shows that dualism is endorsed at a moderate level

in adult populations (Legare et al., 2012), ranging from indirect evidence concerning the beliefs of historical empires (Slingerland & Chudek, 2011) to direct evidence concerning the self-reported beliefs of modern citizens (Cohen, Burdett, Knight, & Barrett, 2011). In terms of the latter category, research shows that university students hold beliefs consistent with mind-body dualism (Dermertzi et al., 2009), clinical psychologists use differential criteria when evaluating physical and mental etiologies (Miresco & Kirmayer, 2006), and members of the scientific academy report moderate support for supernatural phenomena (Larson & Witham, 1997).

Assuming that dualism is almost wholly unsupported from an empirical perspective, it is particularly important to understand why dualistic beliefs continue to exist within a large portion of modern society. Although this belief persistence can be attributed to the general ignorance of scientific research (Lewandowsky et al., 2013) and overarching societal structures that espouse mind-body differentiation (see previous section), an exploration of the psychological literature on human motivation offers several additional explanations for the persistence of mind-body dualism. In the following section, I argue that motivated belief systems are key in promoting the ubiquity of mind-body dualism for many modern human populations.<sup>1</sup>

Numerous social-psychological perspectives argue that humans are motivated to approach, understand, and transmit information in ways that limit negative or threatening cognitions towards the self and one's valued group memberships. Some prominent examples of 'motivated cognition' include research programs on cognitive dissonance (Festinger & Carlsmith, 1959), terror management (Rosenblatt et al., 1989), aversive racism (Dovidio & Gaertner, 2004), and self-handicapping (Berglas & Jones, 1978).



While the particular theoretical arguments underlying these programs are incredibly diverse (for other examples, see Aberson & Ettl, 2004; Cohen et al., 2011; Cooper, 1980; Luginbuhl & Palmer, 1991), they all inherently suggest that individuals process information in systematically-biased ways to maintain positive cognitions about particular aspects of the self (Chaiken & Maheswaran, 1994; Klayman & Ha, 1987; Kunda & Oleson, 1995; Schulz-Hardt, Frey, Luthgens, & Moscovici, 2000; Snyder & Swann, 1978). Below, I argue that dualistic thinking represents a prominent example of motivated cognition that allows individuals to overlook threatening cognitions concerning the inevitability of death, the limitations of free will, and the similarity between the self and social outgroups.

To begin, I argue that dualism allows individuals to believe in the possibility of an afterlife. Research suggests that considering the inevitability of death promotes highly debilitating psychological processes, such as threat, anxiety, and negative emotionality (Dechesne et al., 2003; Pyszczynski, Greenberg, & Solomon, 1999); all of which have the capability to undermine positive motivational and behavioral outcomes. To diminish the operation of such processes, humans have developed a variety of belief systems that presume some aspects of human experience can transcend biological death. From this perspective, it is relatively clear that dualistic beliefs increase the perceived viability of immaterial essences (e.g., soul, spiritual energy); essences which have the potential to remain active when the body ceases to function. Dualism is thus a cornerstone for religious belief systems in which human experience persists over extended time periods (e.g., ascension to heaven, reincarnation), and effectively buffers individuals from cognitions that deteriorate motivation and overall functioning.

In addition to alleviating existential anxiety, dualism has the potential to reinforce free will beliefs. Although the notion of free will has come under increasing scrutiny from various scientific disciplines (e.g., Crick, 1994; Wegner, 2002; for a review, see Kane, 2002), humans are nonetheless motivated to perceive their thoughts and behaviors to be modifiable - rather than predetermined - on a moment-to-moment basis (Paulhus & Carey, 2011; Sarkissian et al., 2010). This perception affords several beneficial psychological outcomes (Kane, 1998), the most significant of which is a sense of agency over the immediate environment (Aarts & van den Bos, 2011). Indeed, without the perception of personal agency, individuals succumb to myriad problematic outcomes, ranging from learned helplessness (Hiroto, 1974) and depression (Benassi, Sweeney, & Dufour, 1988), to poorer achievement (Findley & Cooper, 1983) and heightened stress responses (Houston, 1972). Not surprisingly then, lowering one's belief in free will has far-reaching negative consequences, such as increased interpersonal aggression (Baumeister, Masicampo, & DeWall, 2009), decreased performance output (Stilman et al., 2010), diminished self-control (Rigoni et al., 2012), heightened dishonesty (Vohs & Schooler, 2008), and reduced helping (Baumeister et al., 2009). To avoid these negative psychological and behavioral consequences, humans require worldviews that facilitate and/or strengthen the viability of free will, one of which is mind-body dualism. That is, to truly endorse free will, there needs to be two distinct human systems; one of which (i.e., a higher-order mental system) can monitor, interrupt and override the other (i.e., a lower-order physiological system). As such, dualism appears to serve as a cornerstone for free will beliefs, and thus offers individuals a sense of personal agency within an otherwise random and chaotic natural universe.

In addition to strengthening the viability of spiritual transcension and free will, I argue that dualism affords the perception of human uniqueness, both in terms of the self compared to other individuals, as well as of humans compared to other species. People are highly motivated to distinguish themselves from other humans in their social environment (Bain, Park, Kwok, & Haslam, 2009; Brewer, 1991; Turner, 1987; but see Kim & Marcus, 1999; Rhee, Ulman, Lee, & Roman, 1995) and other animals in their evolutionary history (Boccatto, Capozza, Falvo, & Durante, 2008; Goldenberg, Pyszczynski, Greenberg, & Solomon, 2000; Haslam et al., 2008; but see Epley, Waytz, Akalis, & Cacioppo, 2008). One method to heighten these perceived distinctions is via the invocation of essences that are exclusive to oneself (e.g., personality), one's social ingroup (e.g., moral beliefs), or one's biological species (e.g., cognitive capacities). For instance, Haslam and colleagues (2008) show that participants distinguish nonhuman animals from humans on the basis of dualistic distinctions (see also Gray, Gray, & Wegner, 2007), such that humans possess superior high-level mental capacities (e.g., self-control, refined emotions), whereas animals possess superior low-level physical capacities (e.g., vision, olfaction). Following from these findings, it can be argued that dualism facilitates the perception of self/ingroup uniqueness by inherently increasing the number and viability of dimensions by which different social entities can be distinguished from one another. Without the availability of higher-order mental constructs, many self-other, ingroup-outgroup, and human-nonhuman differences begin to dissipate, as such differences are partially contingent upon unequivocally mental constructs.

## Dualism and Separability

The initial sections of this work have argued that dualistic thinking, while unsupported by scientific research, is embraced by a large subset of modern society. Subsequent sections of this work have offered multiple avenues by which dualistic thinking is formulated and reinforced, ranging from broad societal structures to specific motivational biases. Following from the observations of these previous sections, I conclude is that mind-body dualism is the default method by which human populations interpret their world, such that people naturally dichotomize reality into mental and physical subcategories. *In the present work, I explore one potential consequence of this categorization - the tendency for individuals to perceive ongoing behavioral performance in either physical or mental terms. That is, if mind-body dualism predisposes individuals to separate stimuli into physical and mental subcomponents, it should be possible to isolate an individual's attention to particular subcomponents via contextual and individual differences that activate particular metaphysical perceptions.* Assuming the viability of such contextual (i.e., experimental manipulations) and/or individual (i.e., personality measures) differences, the present work explores whether such differences can impact human cognition and performance. In particular, my dissertation studies explore the consequences of mental and physical task representations within the domain of self-control exertion.

Self-control - the ability to withhold prepotent responses in the service of longer-term goals - represents a hugely productive area of psychological inquiry (Hagger et al., 2010), as well as an area in which mental and physical representations are invoked to describe the same overarching phenomena (e.g., self-control as “willpower” - Baumeister

& Tierney, 2012; self-control as “mental energy” - Gailiot et al., 2007). Given its dualistic nature (see Inzlicht & Schmeichel, 2012; Kurzban et al., 2013; Molden et al., 2012; Vohs et al., 2012), as well as its relevance to critical areas of human behavior (see Hagger, Wood, Stiff, & Chatzisarantis, 2010; Baumeister, Vohs, & Tice, 2007), I chose to focus on self-control exertion as my primary outcome of interest. Specifically, *the present studies utilize manipulations intended to invoke distinct conceptualizations of otherwise equivalent self-control tasks, and assess whether such manipulations - in combination with individual differences in metaphysical belief - can influence subsequent responding on such tasks. More specifically, these studies explore the perceptual, cognitive, and behavioral consequences of situation-level (i.e., mental vs. physical task framing) and individual-level (i.e., lay interactionism) factors that are hypothesized to focus individuals on the physiological or psychological aspects of their self-control performance.* Although there exists no empirical work directly exploring the consequences of metaphysical conceptualizations within the domain of self-control, there are nonetheless several investigations of how individuals perceive the mental and physical aspects of particular psychological stimuli. I describe these previous works below and discuss how their conclusions inform the present work’s predictions.

*Mentalization vs. Mechanization.* One highly relevant example of work that has explored the consequences of metaphysical task framing on human responding is found within the domain of cognitive neuroscience. In particular, researchers have begun investigating divergent patterns of psychophysiological responding when individuals are focused on the *mentalization* or *mechanization* of a given behavior (Lieberman, 2007; 2010; Ochsner et al., 2004; Spunt, Falk, & Lieberman, 2010; Spunt & Lieberman, 2012;

Spunt, Satpute, & Lieberman, 2010; Van Overwalle & Baetens, 2009; Wheatley, Milleville, & Martin, 2007). As a whole, this work suggests differential brain areas are active when considering the physical processes underlying one's behavior (i.e., mechanization) or the mental processes motivating such behavior (i.e., mentalization). For instance, when a person focuses on a target's physical actions, areas such as the ventral premotor cortex and rostral inferior parietal lobule are significantly more engaged, whereas when a person focuses on a target's mental state, areas such as the medial prefrontal cortex and posterior cingulate cortex are significantly more engaged.<sup>2</sup>

Following from this work, conceptualizing self-control behavior in mental (versus physical) terms appears to heighten the potential for improved task performance. That is, the brain areas activated by mentalization (e.g., medial prefrontal cortex) are the same brain areas activated when individuals show enhanced levels of executive function and cognitive control (Gilbert et al., 2007; Wagner et al., 2013), suggesting that the neuroanatomical regions active when considering mental phenomena facilitate effective self-control. While this reasoning is highly indirect, the robust relationship between mentalization and physiological activation in the prefrontal cortex nonetheless offers a pathway by which mental task conceptualizations can spur heightened self-regulatory engagement. For instance, manipulations ranging from emotional (versus physical) perspective-taking, goal-focused (versus action-focused) attention, and psychological (versus physiological) behavioral attributions have all been shown to activate brain regions in the prefrontal cortex (Lieberman, 2007; Spunt et al., 2010), and activating these brain regions facilitates both cognitive and behavioral responding indicative of effective self-control (Heatherton & Wagner, 2011; Juan & Muggleton, 2012).

*Clothed vs. Unclothed.* The divergent consequences of focusing on stimuli's mental and physical properties are also illustrated within work on the relationship between physical appearance and moral reasoning. Although early theoretical perspectives argued that unclothed targets are dehumanized much more so than are clothed targets during person-perception tasks (Nussbaum, 1995; Schwarz & Kurz, 1989), recent work by Gray and colleagues (2011) has offered a more nuanced understanding of the perceptual distinction between clothed and unclothed targets. Specifically, their research has found that individuals with differential amounts of clothing are not ascribed different *levels* of humanity, but rather are ascribed different *types* of humanity. On one hand, clothed individuals receive more mental state attributions than their unclothed counterparts, and are ascribed the status of a *moral actor* (i.e., deemed capable of agency, action, planning, and self-control). In contrast, unclothed individuals, receive more physical state attributions than their clothed counterparts, and are ascribed the status of a *moral patient* (i.e., deemed more capable of experience, pain, pleasure, and other emotional states). Put more simply, the addition of clothing appears to focus individuals on the mental state of the target actor, leading to cognitions focused on the target's potential for action (Gray et al., 2011).

While this type of research has concerned itself primarily with perceptions of external social targets, its findings imply that different metaphysical representations of a particular stimulus promote differential perceptual processes. In particular, focusing on the body leads to increased emphasis on immediate visceral and emotional states, whereas focusing on the mind leads to increased emphasis on overarching goals, motivations, and self-control (Gray et al., 2011). Applied to the present work, this

juxtaposition suggests that manipulations which prime physical constructs should heighten perceptual states associated with immediate experiential feedback during a self-control task (e.g., pain, fatigue), whereas manipulations which prime mental constructs should heighten perceptual states associated with longer-term goals and motivations (e.g., energy capacity, task interest). Because these more immediate perceptions can undermine self-regulatory persistence (Clarkson et al., 2010; Hagger et al., 2010), and less immediate perceptions can bolster self-regulatory persistence (Martijn et al., 2003; Muraven & Slessareva, 2003), it follows that mental task conceptualizations may promote better self-control performance via the operation of perceptual mechanisms.

*Neuroscience vs. Science.* Another domain indirectly concerned with dualistic stimulus conceptualizations involves the study of how lay people perceive different types of scientific explanations. As researchers continue to pinpoint more specific psychophysiological mechanisms underlying human behavior, scholars have begun investigating the extent to which physiologically based evidence is deemed more believable than other types of scientific evidence when explaining a given outcome. Arising from these investigations is a seeming discrepancy in the validity of findings that invoke physical versus mental mediating processes (Beck, 2010; Keehner, Mayberry, & Fischer, 2011; Lilienfeld, 2012; McCabe & Castel, 2008; Weisberg et al., 2008; but see Hook & Farah, 2013; Michael et al., 2013), with neuroscientific explanations (i.e., based on physiological processes) perceived to be more believable than psychological explanations (i.e., based on conceptual demonstration). Furthermore, these effects appear to be especially pronounced when neuroscientific explanations are accompanied by detailed images of the underlying physiological process (Keehner et al., 2011). Such



findings suggest an inherent dichotomy in lay interpretations of physical and mental explanations, with a physical explanation deemed more exacting - and thus more believable - than a corresponding mental explanation.

Following from this work, it stands to reason that manipulations that focus individuals on the physical nature of self-control may increase sensitivity towards perceptual indicators associated with underlying physiological exertion. That is, if priming physical constructs can increase the realism of a given task, then individuals primed to think about a task's physical requirements should be more vigilant towards perceptual cues associated with ongoing physiological exertion. If this is the case, then manipulations that prime a physical focus have the potential to undermine extended self-regulation; for instance, the physiological realism of self-control engagement could heighten the perceived onset of mental fatigue (Job et al., 2010), increase one's motivation towards energy conservation (Muraven et al., 2006), decrease perceived task self-efficacy (Sniehotta, Scholz, & Schwarzer, 2005), or increase sensitivity towards the pain/difficulty elicited by the task (Eccleston & Crombez, 1999). Any of these possibilities implies that self-control performance may be attended to or interpreted differently when a task is conceptualized in physiological terms.

*Abstract vs. Concrete.* Another area of inquiry related to the difference between physical and mental explanations concerns construal level theory (CLT; Trope & Liberman, 2003). In general, CLT posits that as a given situation's psychological distance changes, the type of cognitive processing directed towards this situation is altered in a predictable manner. Specifically, CLT defines several different dimensions of psychological distance, including spatial, temporal, social, and hypothetical. As an event

is construed in more distal terms, regardless of the type of distance invoked (Fiedler, Jung, Wänke, & Alexopoulos, 2012; Maglio, Trope, & Liberman, 2012), this event is perceived more holistically, thought of in terms of its desirability, and conceptualized in terms of its central features (Liberman & Trope, 1998; Trope & Liberman, 2000; 2010). Interestingly, research suggests that physical and mental task framings lead to reliable changes in one's overall construal level, such that focusing a stimulus' mental properties leads to higher overall construal levels (Liberman, 2007; Liberman, Trope, McCrea, & Sherman, 2007; Spunt et al., 2010; Trope & Liberman, 2010). For instance, participants primed to attend to an action's mental properties show a stronger focus on the distal temporal context surrounding this action (Liberman, Trope, McCrea, & Sherman, 2007).

In the event that focusing on the mental aspects of behavior leads to the extension of perceptual scope, it follows that these changes can strongly influence self-control exertion. Specifically, previous work suggests that abstract construals tend to promote more effective self-control behavior than do concrete construals (Fujita & Carnevale, 2012; Fujita, Trope, Liberman, & Levin-Sagi, 2006). In a seminal paper on this topic, Fujita and colleagues (2006) showed that, across a variety of self-control tasks and a variety of primed psychological distances, participants who thought in higher-level terms exhibited higher overall self-control exertion and self-control effectiveness. Although such findings have been extended and moderated in more recent experiments (Egan, Han, & Hirt, 2015; Fujita & Han, 2009; Fujita & Roberts, 2010; Schmeichel & Vohs, 2009; Schmeichel, Vohs, & Duke, 2012; Wan & Agrawal, 2011; White, MacDonnell, & Dahl, 2012), the general consensus remains that abstract construals promote more effective self-control than do concrete construals (Fujita, 2008). In explaining such findings, one

pronounced possibility is that thinking abstractly focuses individuals on the higher-order goals and motivations underlying their behavior, and these cognitions drive subsequent alterations in effortful exertion (e.g., Muraven & Slessareva, 2003; Trope & Fishbach, 2000).

*Limited vs. Unlimited Willpower.* A final literature in which mental and physical constructs are shown to elicit differential consequences is within the domain of self-control exertion. Although researchers have yet to explore the ramifications of construing self-control tasks in relatively mental or physical terms, researchers have nonetheless begun exploring how particular mental and physical metaphors influence self-control exertion. Beginning with Martijn and colleagues (2003) and continuing with Job and colleagues (2010), theorists have conducted numerous works that compare self-control exertion as a function of how self-control capacity is construed (see also Job, Walton, Bernecker, & Dweck, 2013; Job, Walton, Bernecker, & Dweck, 2014; Miller et al., 2012). As a whole, these works find that when self-control exertion is thought of as a limited resource, participants show lower effectiveness on conventional metrics of self-control. For instance, Job et al. (2010; 2013) demonstrate that non-limited theorists show relative immunity to conventional depletion effects over time (but see Vohs, Baumeister, & Schmeichel, 2012). Because construing willpower as unlimited corresponds with statements endorsing the psychological - as opposed to physiological - nature of self-control (Job et al., 2010; see Appendix 2), the above findings suggest that self-control is diminished when individuals focus on the physical basis of their performance.

Although these works tend to focus on how individuals conceptualize self-control as a whole (rather than how they conceptualize any particular self-control task under

study), they nonetheless suggest that emphasizing the physical aspects of self-control exertion can undermine self-regulation. There exist several possibilities to explain this general relationship between lay beliefs and self-regulatory effectiveness. For instance, individuals might simply show lesser behavioral responsiveness to physical terminology, based upon their heightened familiarity with mental terminology in conventional descriptions of self-control (i.e., “willpower”, Baumeister & Tierney, 2011). Alternatively, individuals may be less motivated to exert self-control following the inclusion of physical terminology, because such terminology is less relevant to one’s personal identity in societies which increasingly value mental capabilities (Haslam et al., 2008). Finally, it is possible that physical constructs alter one’s conceptualization of energization in manners that facilitate lower perceptions of available energy or motivation (Clarkson, Hirt, Jia, & Alexander, 2010; Clarkson, Hirt, Chapman, & Jia, 2011; Ryan & Frederick, 1997), such that the experience of physical fatigue is less ambiguous than analogous experiences of mental fatigue, thus causing individuals primed with physiological constructs to perceive fatigue more readily and/or more severely than individuals primed with psychological constructs.

## **Outline**

The purpose of the present work is to explore the role of mental and physical framings on the performance of extended self-control tasks. Given that self-control performance is often indexed by tasks involving a combination of physical and psychological inputs (e.g., handgrip persistence, Muraven et al., 1998; pain tolerance, Schmeichel & Vohs, 2009), the present studies examine how conceptualizing these “hybrid” self-control tasks in terms of their physical/mental requirements impacts overall

performance. Additionally, these studies explore the perceptual and cognitive consequences of metaphysical task framings, and assess how such perceptual and cognitive responses predict behavioral performance. Together then, the present work examines the independent and interactive effects of contextual manipulations (i.e., mental, physical, or neutral) and individual differences (i.e., lay interactionism) on subjective and objective indicators of self-control ability.

Before conducting these primary studies, I deemed it necessary to validate the particular individual difference measurement to be utilized in my primary studies. Specifically, Study 1 assessed the reliability and validity of a novel metric conceptualized as *lay interactionism*. Generally speaking, lay interactionism refers to a layperson's intuitive beliefs concerning the perceived interrelation between physical and mental phenomena. Individuals who score high on this index are argued to perceive a greater amount of overlap between mental and physical phenomena (i.e., high interactionists), whereas individuals who score low on this index are argued to perceive a lesser amount of overlap between such phenomena (i.e., low interactionists). Identifying this construct was of high practical and theoretical import to the present work, as I anticipated that lay interactionism would moderate the effect of the mental/physical framing manipulations under study (see Predictions). Using previous pilot data as a starting point, I exposed participants to numerous questions concerning the overlap between mental and physical phenomena, and assessed the reliability and validity of this index.

Following this initial study, I conducted several experiments concerning the influence of LI, along with situational manipulations of mental/physical task framing, on one's perceptual, cognitive, and behavioral responses to different types of self-control

assessments. First, Study 2 exposed individuals to a difficult handgrip persistence task, and utilized differential electrode placement during this task as a manipulation of mental/physical framing. Participants in the neutral condition completed the handgrip task in the absence of electrode attachments, whereas participants in the physical condition had electrodes attached to their arm to ostensibly measure physiological responses, and participants in the mental condition had electrodes attached to their temples to ostensibly measure psychological responses. Next, Study 3 exposed individuals to a difficult cold pressor task (CPT), and utilized differential story primes before this task as a manipulation of mental/physical framing. Participants in the control condition read a domain-neutral story about student-athletes, whereas participants in the physical condition read a story that focused on physiological consequences of student-athlete life, and participants in the mental condition read one focused on psychological consequences. Finally, Study 4 exposed individuals to a Stroop interference task, which was preceded by the same framing manipulation as Study 3. Within each of these studies, participant responding was measured using multiple metrics, including self-control behavior, task perceptions, and subjective experience.

## **Predictions**

Whether one considers that mental and physical phenomena are processed via distinct neurological pathways (e.g., Lieberman, 2007), perceived as differentially valid scientific explanations (e.g., Weisberg et al., 2008), associated with different levels of moral agency (e.g., Gray et al., 2011), predictive of opposing construal levels (e.g., Spunt et al., 2010), or conducive to different lay theories of willpower (e.g., Job et al., 2010), I anticipated that manipulating the metaphysical framing of a self-control task would

produce divergent patterns of responding in terms of perceptual, cognitive, and behavioral outcomes. I outline my main predictions below, which are sorted by the type of response in question. Predictions concerning the effect of condition in Studies 2-4 are presented at the outset, followed by predictions concerning the interaction between condition and LI in a later subsection.

*Self-Perception.* Much recent work suggests that perceptions of fatigue can mediate the amount of effort exerted by an individual in numerous self-control contexts. Specifically, research has shown that information altering one's beliefs in the malleability of willpower (Job et al., 2010), the energy value of yellow paper (Clarkson et al., 2010), or the restorative potential of certain states (interpersonal power, Egan & Hirt, 2015; positive mood, Egan et al., 2015) can influence corresponding metrics of subjective fatigue; metrics which predict subsequent self-control effectiveness. Applied to the present work, I reasoned that the experimental manipulations under study should influence individuals' self-perceptions in manners predictive of self-control exertion. In particular, I hypothesized that *mental framing manipulations should decrease subjective indicators of impending self-control failure*. As such, individuals exposed to mental frames should report less pain and difficulty on the primary behavioral metrics used in each study.

*Task Perceptions.* In addition to perceptual changes regarding the self, I also sought to investigate how the manipulations under study influenced perceptual changes towards the tasks under study. That is, even if individuals report no differences in their self-perceived pain or difficulty, they may still differ in perceptions concerning the task under study. As such, each experiment asked participants closed-ended (e.g., "How

mentally/physically challenging was the task?") and/or open-ended (e.g., "Please list your thoughts about the task") questions about the self-control task subsequent to its completion. Generally speaking, these questions afforded an assessment of the experimental manipulation's effectiveness, as well as an assessment of the LI metric's construct validity. For one, I expected that the *mental framing manipulations would cause individuals to perceive the self-control task in more mental terms, whereas the physical framing manipulations would cause individuals to perceive the self-control task in more physical terms*. Second, I expected that *participants high in LI would be more likely to perceive the task in both physical and mental terms*.

*Motivation.* In addition to perceptions of the task's metaphysical nature, another key process by which the manipulations under study might impact self-control effectiveness is via motivational changes. Specifically, individuals primed with mental task information may report higher motivation to engage with subsequent self-control tasks, given that mental tasks are deemed more intrinsically important (Muraven & Slessareva, 2003), personally relevant (Ryan & Deci, 2000), or less sensitive to fatigue (Job et al., 2010; Muraven et al., 2006). As such, the present studies measured motivation via both retrospective (i.e., How motivated were you to complete the task?), and prospective (i.e., How willing would you be to complete another task after these questions?) self-report items. Following from a general positive association between motivation and self-control exertion (Hagger et al., 2010), I hypothesized that *mental framing manipulations would lead to higher levels of motivation towards the self-control task under study*.



*Behavior.* Although perceptual and motivational changes are important in understanding the processes underlying performance, conventional behavioral measurements of self-control effectiveness nonetheless represent the most important dependent variable under study. Generally speaking, I anticipated that the experimental manipulations utilized in Studies 2-4 would lead to reliable changes in behavioral self-control exertion. In particular, I hypothesized that *the mental framing manipulations would lead to greater overall self-control exertion*. That is, when individuals were primed to perceive the self-control task in more mental terms, I anticipated that they would be more likely to elicit high levels of behavioral self-control in terms of handgrip stamina (Study 2), CPT persistence (Study 3), or Stroop effectiveness (Study 4).

*Condition x LI Interaction.* In addition to the main effects discussed above, a key component of the present work concerns the interaction between the framing manipulation and the primary individual difference measure (i.e., LI). That is, the central reason LI is outlined and developed in Study 1 is to explore the potential of Person x Situation interaction effects in subsequent studies. In general, these types of interaction effects are increasingly commonplace in social-psychological research, with the influence of contextual manipulations being contingent upon the presence of particular person-level perceptions, beliefs, and traits (Kihlstrom, 2010). For instance, the effects of self-control depletion (Job et al., 2010), interpersonal power (Maner & Mead, 2010), implicit attitudes (Son Hing, Chung-Yan, Hamilton, & Zanna, 2008), stereotype threat (Schmader, 2002), cognitive dissonance (Zanna, Olson, & Fazio, 1980), and mood (Egan et al., 2015) are all strongly moderated by individual difference measurements relevant to the psychological processes underlying their respective manipulations. These robust

patterns imply that when seeking to develop novel contextual manipulations (i.e., mental vs. physical task framing), it is crucial for researchers to explore the possibility that their manipulation's effects are constrained/accentuated by relevant individual differences.

Because personal beliefs about mental-physical overlap should theoretically influence one's tendency to distinguish between mental and physical task information, I reasoned that LI would interact with the experimental manipulations under study to produce nuanced patterns of perceptual, cognitive, and behavioral responding. In general, I predicted that manipulations designed to alter metaphysical conceptualization of a given self-regulatory task would be less efficacious as a function of increasing levels of lay interactionism. On one hand, *low LI participants should show greater perceptual assimilation to the experimental manipulations under study*, because they more readily differentiate between the mental and physical aspects of a given task. In other words, because non-interactionists endorse minimal overlap between mental and physical phenomena, they should show less activation of mental task perceptions when primed with information focused on physical constructs, and should show less activation of physical task perceptions when primed with information focused on mental constructs. On the other hand, *high LI participants should show greater perceptual contrast to the experimental manipulations under study*, because they less readily differentiate between the mental and physical aspects of a given task. That is, because high interactionists endorse high overlap between mental and physical phenomena, they should show greater activation of physical task perceptions when primed with information focused on mental constructs, and should show greater activation of mental task perceptions when primed with information focused on physical constructs.

*Other Person x Situation Interaction Effects.* Given that LI represents only one of many individual differences relevant to self-control exertion, the present work also included several additional individual difference measures, each of which held the potential to interact with the experimental manipulations under study. In particular, all studies included self-report indices of lay theories of willpower (LTW; Job et al., 2010; lay beliefs concerning the extent to which self-control is a limited or non-limited capacity) and trait self-control (TSC; Tangney, Baumeister, & Boone, 2004; extent to which an individual perceives him/herself to have high self-control) in order to assess whether these individual differences interact with the experimental manipulations under study to produce novel patterns of perceptual, cognitive, and/or behavioral responding. However because these individual differences are only indirectly related to the primary interests of the present work, and because their respective analyses substantially increase the complexity of the present manuscript, all findings concerning these supplemental individual differences are included within Appendix 8.

In terms of predictions for these supplemental individual differences, I hypothesized that LTW could moderate the effect of the experimental manipulations under study. Because non-limited theorists show less sensitivity to the aversive effects of self-control depletion (Job et al., 2010; Vohs, Baumeister, & Schmeichel, 2012), it is possible that these individuals may be less affected by the influence of the experimental manipulations in Studies 2-4. More specifically, if non-limited theorists are relatively unaffected by the presence of mental fatigue and difficulty (Job et al., 2010; Study 3), such individuals may be unaffected by any perceptual changes induced by the experimental manipulations (increased pain, altered task construal, decreased

motivation). Put another way, limited willpower theorists are more likely to be guided by perceptual and cognitive indicators of impending self-regulatory failure, therefore making these individuals increasingly likely to show altered behavioral responding following a manipulation intended to alter their perceptual focus. Following this reasoning, I predicted an interaction between the experimental manipulations and LTW, such that the relative difference between the physical and mental primes would be most pronounced among limited - rather than non-limited - willpower theorists.

Second, I hypothesized that trait self-control (TSC; Tangney, Baumeister, & Boone, 2004) could moderate the effect of the experimental manipulations under study. In making this prediction, I reasoned that the experimental manipulations would be more likely to impact the self-control performance of individuals who are inherently more variable in their everyday self-control effectiveness. It follows that low TSC participants, who report more propensity towards impulsive behavior and decision-making (Tangney et al., 2004), may be especially sensitive to situational manipulations with the potential to impact self-regulatory performance. Put another way, high TSC individuals should show more stability in their self-regulatory performance across situations, thus causing such individuals to be less influenced by contextual manipulations that might otherwise affect self-control effectiveness. As such, I anticipated an interaction between the experimental manipulations and TSC, such that the relative difference between the physical and mental primes would be most pronounced among low - rather than high - TSC individuals.

*Control Variables.* In addition to assessing the effects of my primary experimental manipulation, my primary individual difference measure, and several secondary individual difference measures, I also sought to include additional transient state

measurements to isolate the influence of the factors listed above. In particular, Studies 2-4 included measures of mood and perceived mental depletion prior to the manipulation under study, both of which were adapted from prior research (Tice, Baumeister, Shmueli, & Muraven, 2007; Clarkson, Hirt, Jia, & Alexander, 2010). Because there exists several studies which associate positive mood with effective self-regulatory behavior (Fredrickson, Mancuso, Branigan, & Tugade, 2000; Tice et al., 2007; but see Egan et al., 2015), as well as studies that associate perceived mental depletion with ineffective self-regulatory behavior (Clarkson et al., 2010; Clarkson, Hirt, Chapman, & Jia, 2011; Muraven, Gagne, & Rosman, 2008; but see Job et al., 2010), the analyses in Studies 2-4 assessed and subsequently controlled for the effects of mood and perceived mental depletion. Aside from transient state measurements, the present work also attempted to account for any potential differences associated with participant gender. Given that several of the self-control tasks under study show differential performance as a function of gender (handgrip persistence, Demura, Nakada, & Nagasawa, 2008; Hicks, Kent-Braun, & Dikar, 2001; CPT performance, Mitchell, MacDonald, & Brodie, 2004), the analyses in Studies 2-4 assessed and subsequently controlled for the influence of participant gender.

*Mediation.* Because the experimental manipulations under study are hypothesized to affect perceptual (e.g., subjective pain), motivational (e.g., willingness to complete the task), and behavioral (e.g., task persistence) indices, it is possible that behavioral effects may be partially or fully attributable to perceptual or motivational changes. That is, if the manipulation is shown to influence self-control performance, it stands to reason that these effects may be due to changes in task perceptions (Laran & Janiszewski, 2011),

subjective pain (Eccleston & Crombez, 1999), or overall motivation (Muraven et al., 2006; 2008; Muraven & Slessareva, 2003). To account for these possibilities, in any case for which the experimental manipulation affected multiple dependent measures in a similar direction, I conducted exploratory mediational analyses to assess the extent to which subjective and/or motivational changes explained the behavioral changes under study (Baron & Kenny, 1986; Preacher & Hayes, 2004; Shrout & Bolger, 2002).

*Summary.* In general, the present studies attempt to (1) develop an individual difference of lay interactionism (i.e., the perceived amount of interaction between physical and mental phenomena), and then (2) utilize this individual difference in conjunction with experimental manipulations of metaphysical focus (e.g., attaching electrodes to one's temples or biceps) to predict novel patterns of perceptual, cognitive, and behavioral responding on a variety of self-control tasks (i.e., handgrip exertion, cold pressor persistence, Stroop interference). Given the novelty of the present inquiry, and the corresponding lack of prior work to guide the present approach, I present several pilot studies within Appendix 1 to establish the validity of the measures and manipulations under study.

### **Study 1**

The first step in the present work was to develop an individual difference measure concerning the perceived overlap between physical and mental phenomena. For the purposes of the present work, this individual difference will be described as lay interactionism (LI). In philosophical terms, interactionism refers to the interrelation between mental and physical processes, effectively serving as a moderate perspective between the extreme stances of *physicalism* (i.e., all phenomena are produced via

physical processes) and *idealism* (i.e., all phenomena are produced via perceptual processes). Given the extremity of these alternative perspectives, as well as the fact that most theological systems endorse a hybrid between such perspectives, an assessment of LI theoretically affords the greatest amount of accessibility and individual variability when measuring participants' metaphysical beliefs.

To develop this assessment of LI, Study 1 borrowed from a previous pilot study, which focused specifically on an assessment of LI and its relationship to other individual differences (see Appendix 1, Study 1). This initial LI assessment was comprised of items assessing the perceived influence of mental processes on physical outcomes (e.g., “Experiencing stress and anxiety directly leads to physical health problems”) and vice-versa (e.g., “Getting in better physical shape improves a person’s intellectual abilities”), with higher scores indicating greater presumed overlap between mental and physical phenomena. Although the results of this pilot study failed to establish a reliable index of LI, it nonetheless supported the notion that (1) LI could be measured effectively with improvements to the scalar items, and (2) that LI was statistically related to other individual differences relevant to mind-body beliefs. As such, Study 1 utilized a revised version of this LI index, by both altering the wording of low reliability items (e.g., switching all items to third-person perspective) and supplementing the index with additional items assessing interactionism in similar contexts (e.g., health, fatigue).

Using this updated index, Study 1 assessed the inter-item reliability of LI, as well as its statistical relationship to other individual differences both directly (e.g., mind-body overlap, Forstmann et al., 2012; metaphysical beliefs, Preston, Ritter, & Hepler, 2013) and indirectly (lay theories of willpower, Job et al., 2010; faith in intuition, Epstein et al.,

1996; perspective-taking, Davis, 1983) related to beliefs in mental-physical overlap. Given the exploratory nature of this study, I also included a variety of other individual differences used in social-psychological research both within (e.g., trait self-control, Tangney et al., 2004; private self-consciousness, Fenigstein, Scheier, and Buss, 1975; need for cognition, Cacioppo & Petty, 1982) and outside (e.g., Big Five personality, Dingman, 1989; need for closure, Webster & Kruglanski, 1994; self-handicapping scale, Jones & Rhodewalt, 1982) the domain of self-control.

Although the purpose of this study was inherently exploratory, there were several predictions worth noting at the outset. For one, I anticipated that LI would form a reliable psychological index. In addition, I anticipated that LI would (1) correlate with individual differences directly related to metaphysical beliefs (i.e., mind-body dualism, mind-body overlap), (2) correlate with individual differences requiring an endorsement of mind-body connectedness (e.g., private body consciousness, faith in intuition), and (3) not correlate with individual differences orthogonal to mind-body beliefs (e.g., Big Five personality, trait self-control, need for closure). Finally, I anticipated that LI would be more predictive of individual differences requiring an endorsement of mind-body connectedness than would the other metaphysical individual differences under study.

## **Method**

### **Participants**

149 participants (98 female) from Indiana University were recruited for the present study, and all received partial course credit for participation. Participants were recruited via an in-class assignment for a social psychology course, and each completed the study using a pencil-and-paper format within their classroom. Because of the number



of individual difference measures utilized, as well as the desire to minimize demand characteristics, the study was completed across three separate data collections that spanned the course's 12-week duration. Twenty-three participants were removed from analysis for failing to complete all data collections, leaving 126 participants (87 female) for analysis within the final dataset.

### **Procedure**

Participants read instructions regarding the purpose of the present study and provided consent, after which they were presented with a survey in paper format. In each data collection session, this survey began with demographic information, continued to questions concerning the individual differences under study, and concluded with a short debriefing concerning the nature of the measurements.

### **Measures**

For space purposes, the individual difference measures of the present study are presented in brief format within the main text. However, all such measures are explicated in full detail within Appendix 2.

*Lay Interactionism (LI)*. The LI scale was designed to assess the extent to which participants perceive an interaction between seemingly mental and physical phenomena in their everyday lives (e.g., "A person's body posture influences their mental state."). Higher scores indicate a greater perceived overlap between mental and physical experience ( $\alpha = .77$ ). It should be noted that the reliability of this scale exceeded that which was achieved in previous pilot work, and represents a moderate level of psychometric consistency.

*Lay Theories of Willpower (LTW)*. Established by Job and colleagues (2010; 6 items), the LTW scale asks participants about their overall beliefs in the limited/unlimited nature of willpower and mental energy (e.g., “After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again.”). Higher scores indicate greater belief in the idea of willpower as an unlimited resource ( $\alpha = .89$ ).

*Trait Self-Control (TSC)*. Established by Tangney and colleagues (2004; 13 items), the TSC scale asks participants about their self-perceived ability to resist temptation and desire in their everyday lives (e.g., “I am good at resisting temptation.”). Higher scores indicate greater self-perceived self-control abilities ( $\alpha = .83$ ).

*Self-Control as Energy (SCE)*. Established by Martijn and colleagues (2003; 10 items), the SCE scale asks participants about the extent to which they conceptualize self-control as a depletable energy resource (e.g., “I get tired when I have to control myself.”). Higher scores indicate a stronger perception that self-control is energy-dependent ( $\alpha = .90$ ).

*Self-Control as State of Mind (SCSM)*. Also established by Martijn and colleagues (2003; 10 items), the SCSM scale asks participants about the extent to which they conceptualize self-control as an unlimited personal resource (e.g., “If you really want to, there are no limits to the extent to which you can control yourself.”). Higher scores indicate a stronger perception that self-control is energy-independent ( $\alpha = .76$ ).

*Generalized Self-Efficacy (GSE)*. Established by Schwarzer and Jerusalem (1995; 8 items), the GSE scale asks participants about the extent to which they perceive themselves as capable of achieving important personal outcomes (e.g., “In general, I

think that I can obtain outcomes that are important to me.”). Higher scores indicate a stronger sense of personal self-efficacy ( $\alpha = .92$ ).

*Free Will (FW)*. Established by Paulhus and Carey (2011; 7 items), the FW scale assesses the extent to which participants endorse the notion of personal free will (e.g., “People have complete free will.”). Higher scores indicate a higher belief in free will ( $\alpha = .87$ ).

*Categorical Thinking (CT)*. Established by Epstein and Meier (1989; 3 items), the CT scale assesses the extent to which participants engage in rigid categorical thinking (e.g., “There are basically two kinds of people in this world, good and bad.”). Higher scores indicate stronger tendencies to think categorically about the world ( $\alpha = .66$ ).

*Faith in Intuition (FI)*. Established by Epstein and colleagues (1996; 12 items), the FI scale asks participants about their overall trust in their gut reactions in various contexts (e.g., “I believe in trusting my hunches.”). Higher scores indicate greater trust in one’s intuitive reasoning ( $\alpha = .75$ ).

*Connectedness to Nature (CNS)*. Established by Mayer and Frantz (2004; 14 items), the CNS scale asks participants about their self-perceived overlap with the natural world (e.g., “When I think of my life, I imagine myself to be part of a larger cyclical process of living.”). Higher scores indicate greater connection to the natural world ( $\alpha = .84$ ).

*Private Body Consciousness (PBC)*. Established by Miller and colleagues (1981; 5 items), the PBC scale asks participants about their overall attunement to internal physiological states within their body (e.g., “I am sensitive to internal bodily tensions.”). Higher scores indicate greater attunement to one’s internal physiology ( $\alpha = .55$ ).

*Religiosity (REL)*. Established by Koenig and Büssing (2010; 4 items), the REL scale asks participants about their overall connection to a higher spiritual entity (e.g., “In my daily life, I experience the presence of a divine entity (e.g., God).”). Higher scores indicate greater religiosity ( $\alpha = .95$ ).

*Mind-Body Dualism (MBD)*. Established by Preston and colleagues (2013; 14 items), the MBD scale assesses the extent to which participants endorse various high-level metaphysical statements indicative of mind-body dualism (e.g., “The mind is equivalent to the brain.”). Higher scores indicate a stronger preference for dualism, as opposed to physicalism ( $\alpha = .79$ ).

*Mental-Physical Overlap (MPO)*. Established by Forstmann, Burgmer, and Mussweiler (2012; 1 item), the MPO item asks participants to indicate, on a series of increasingly-overlapping Venn diagrams (7 in total), the extent to which they believe that physical and mental processes are interrelated. Higher scores indicate greater perceived overlap between physical and mental processes.

*Perspective-Taking (PT)*. Established by Davis (1983; 7 items), the PT scale assesses the extent to which a person engages in perspective taking within various interpersonal situations (e.g., “When I'm upset at someone, I usually try to "put myself in their shoes" for a while.”). Higher scores indicate a greater tendency to take the perspective of other individuals ( $\alpha = .74$ ).

*Lay Theory of Intelligence (LTI)*. Established by Dweck, Hong, and Chiu (1993; 8 items), the LTI scale assesses the extent to which a person believes that intelligence is a static or malleable human entity (e.g., “You have a certain amount of intelligence, and

you can't really do much to change it.”). Higher scores indicate a stronger belief that intelligence is a fixed trait ( $\alpha = .95$ ).

*Grit (GRT)*. Established by Duckworth, Peterson, Matthews, and Kelly (2007; 12 items), the GRT scale assesses the extent to which a person tends to persist on long-term goals in their everyday life (e.g., “I have overcome setbacks to conquer an important challenge.”). Higher scores indicate a higher tendency to approach and complete difficult long-term goals ( $\alpha = .78$ ).

*Academic Contingencies of Self-Worth (ASCW)*. Established by Crocker, Luhtanen, Cooper, and Bouvrette (2003; 5 items), the ASCW scale assesses the extent to which a person’s academic performance is central to their overall self-concept (e.g., “Doing well in school gives me a sense of self-respect.”). Higher scores indicate a stronger internal association between personal academic success and self-esteem ( $\alpha = .69$ ).

*Need for Cognition (NFC)*. Established by Cacioppo and Petty (1982; 18 items), the NFC scale assesses a person’s overall enjoyment of cognitively demanding contexts (e.g., “I would prefer complex to simple problems.”). Higher scores indicate a greater preference for engaging in high-level cognition ( $\alpha = .92$ ).

*Need for Closure (NFCL)*. Established by Webster and Kruglanski (1994; 42 items), the NFCL scale asks participants about their preferences for certainty and cognitive closure (e.g., “I think that having clear rules and order at work is essential for success.”). Higher scores indicate a greater preference for cognitive closure ( $\alpha = .82$ ).

*Private Self-Consciousness (PSC)*. Established by Fenigstein, Scheier, and Buss (1975; 10 items), the PSC scale assesses the extent to which participants are aware of

their underlying psychological state (e.g., “I’m often the subject of my own daydreaming and imaginings.”). Higher scores indicate a greater attunement to one’s ongoing mental processes ( $\alpha = .71$ ).

*Self-Handicapping (SH)*. Established by Jones and Rhodewalt (1982; 47 items), the SH scale asks participants about their tendencies to engage in various forms of self-handicapping, or the intentional undermining of performance to protect self-esteem (e.g., “I tend to put things off to the last moment.”). Higher scores indicate a greater propensity to engage in both claimed and behavioral self-handicapping ( $\alpha = .81$ ).

*Worker Scale (WRK)*. Established by McCrea and colleagues (2008; 10 items), the WRK scale asks participants about the extent to which they value effort and hard work (e.g., “If I don’t work my hardest, I feel like I let myself down.”). Higher scores indicate a stronger valuation of effort ( $\alpha = .73$ ).

*Self-Esteem (SE)*. Established by Rosenberg (1965; 10 items), the SE scale assesses a person’s self-perceived sense of value and importance (e.g., “On the whole, I am satisfied with myself.”). Higher scores indicate a stronger belief in the self as valuable and successful ( $\alpha = .91$ ).

*Self-Monitoring (SM)*. Established by Snyder (1974; 25 items), the SM scale assesses the extent to which a person engages in the monitoring and alteration of ongoing behavior to match the surrounding social context (e.g., “When I am uncertain how to act in a social situation, I look to the behavior of others for cues.”). Higher scores indicate a greater tendency to monitor and alter one’s behaviors and preferences ( $\alpha = .70$ ).

*Big Five Personality Index*. Established by Dingman (1989; 44 items), the Big Five is a widely-utilized assessment of overall personality, which is broken into five

distinct subscales. In particular, this index assesses openness to experience (OPN; 10 items;  $\alpha = .77$ ; e.g., “Is original, comes up with new ideas”), conscientiousness (CON; 9 items;  $\alpha = .79$ ; e.g., “Is a reliable worker”), extraversion (EXT; 8 items;  $\alpha = .89$ ; e.g., “Is full of energy”), agreeableness (AGR; 9 items;  $\alpha = .82$ ; e.g., “Is considerate and kind to almost everyone”), and neuroticism (NRT; 8 items;  $\alpha = .82$ ; e.g., “Worries a lot”).

## **Results**

Upon establishing the reliability of the LI index ( $\alpha = .77$ ), the primary concern of the present study was to understand how this index relates to the other individual difference measures under study. As such, I correlated participants’ responses on all of the individual differences measured within the present work, the results of which are presented in Table 1. Below, I outline these correlations, and discuss the possible importance of such relationships in understanding the underlying nature of LI.

### **Metaphysical Beliefs**

The first important correlations to be examined concerned the extent to which LI corresponded with extant validated measurements of metaphysical beliefs. As expected, high LI individuals were more likely to (1) endorse philosophical statements establishing the viability of mind-body dualism (MBD;  $r = .21, p = .02$ ) and (2) report that mental and physical phenomena overlap in conceptual space (MPO;  $r = .55, p < .001$ ). The former result suggests that LI is relatively contingent upon the ability of individuals to perceptually separate mental and physical experience (i.e., interactionism is more viable when there are multiple concepts present to interact), thus providing a measure of construct validity to the LI index. The latter result suggests that the cognitive statements contained within the LI index are interpreted in a similar fashion to more intuitive figural

assessments of mind-body overlap, thus providing a measure of face validity to this index. Given that MPO and MBD also positively correlate with one another ( $r = .19, p = .04$ ), the present results offer support for the viability of LI as a novel verbal - rather than figural - assessment of the perceived interaction between psychological and physiological experience.

### **Experiential Integration**

Related to the endorsement of mind-body interactionism is the integration of psychological and physiological states within an individual. That is, individuals who are skilled at integrating mental and physical experience should be those individuals who perceive a correspondence between such experiences in their everyday lives. Consistent with this reasoning, high LI individuals were more likely to report (1) greater awareness of their ongoing physiological states (PBC;  $r = .28, p = .002$ ), (2) greater awareness of their ongoing emotional and psychological experiences (PSC;  $r = .26, p = .004$ ), (3) higher psychological connectedness with the external world (CNS;  $r = .15, p = .09$ ), and (4) greater recognition of the psychological and physiological experiences of other social actors (PT;  $r = .27, p = .003$ ). While each of these results only offers partial support for the construct validity of LI, they nonetheless imply that LI positively relates to one's tendency to integrate ongoing psychological experience with potentially distinct external sources (i.e., one's physiology, emotion, natural environment, social environment). The only metric relevant to experiential integration that was not positively correlated with LI was an individual's trust in intuitive judgments (FII:  $r = .11, p = .22$ ), a metric presumed to capture the influence of physiological markers on cognitive decision-making. However, given that intuition is not necessarily conceptualized as a physiological



reaction in all populations, it is possible that the weaker correspondence between LI and this index concerns variability in one's metaphysical conceptualization of intuitive processes.

### **Other Individual Differences**

In addition to examining statistical relationships between LI and individual differences relevant to interactionist beliefs, I also sought to examine statistical relationships between LI and individual differences that are relatively orthogonal to such beliefs. For one, LI was unrelated to general personality characteristics (OPN:  $r = .05, p = .59$ ; CON:  $r = .01, p = .96$ ; EXT:  $r = .09, p = .30$ ; AGR:  $r = .01, p = .96$ ; NRT:  $r = .05, p = .61$ ), self-esteem (RSE:  $r = .11, p = .24$ ), and religiosity (REL:  $r = .11, p = .21$ ), all of which converge to suggest that LI cannot be simplified into a indirect assessment of more general personal characteristics. Furthermore, LI was unrelated to free will beliefs (FWB:  $r = .13, p = .14$ ), as well as to predispositions towards categorical thinking (CT:  $r = -.02, p = .83$ ), both of which are thought to underlie dualistic thinking more generally. Thus, although generalized beliefs in mind-body dualism (MBD) tend to predict both the endorsement of free will ( $r = .21, p = .02$ ) and the tendency to think categorically ( $r = .14, p = .11$ ), the fact that LI associates less reliably with such outcomes implies that it is conceptually distinct from generalized dualistic beliefs. Finally, and contrary to predictions, LI corresponded reliably with several metrics associated with engaged and effective cognitive performance. That is, LI was positively associated with tendencies to (1) engage in high-level cognition (NFC:  $r = .31, p < .001$ ), (2) value academic achievement (ASW:  $r = .42, p < .001$ ), (3) value the utilization of effort (WRK:  $r = .41, p < .001$ ), and was negatively associated with the tendency to self-handicap (SH:  $r = -.23, p$

= .01). While such results cover a broad range of psychological constructs, they all imply that high LI individuals are highly motivated to engage in cognitive pursuits and difficult tasks, perhaps suggesting that they have stronger levels of self-control and overall goal obtainment (but see below). At the very least, such findings highlight the interrelatedness of valuing cognitive activity and endorsing mental-physical overlap.

### **Self-Control Perceptions and Performance**

Given the focus of the present research, I also examined how LI relates to individual differences that are specific to self-control performance. For one, LI positively correlated with perceptions of self-control as energy-dependent (SCE:  $r = .24, p = .01$ ), and a state of mind (SCSM:  $r = .25, p = .01$ ), but did not correlate with perceptions of self-control as a limited resource (LTW:  $r = .13, p = .15$ ). Together, these findings suggest that high LI individuals more readily perceive the physical (i.e., self-control relies upon physiological resources) and mental (i.e., self-control relies upon determination and motivation) requirements of self-control. Furthermore, such findings suggest that LI allows for variability in one's theoretical assumptions about self-control depletion. That is, because LTW is positively associated with SCE ( $r = .35, p < .001$ ) and negatively associated with SCSM ( $r = -.26, p = .003$ ), the fact that LI is positively associated with both SCE and SCSM leads to a relatively weak relationship between LI and LTW.

In addition to exploring the relation between LI and cognitive representations of self-control, the present work also explored the relation between LI and metrics of behavioral self-control success. LI was positively related to generalized efficacy beliefs (GSE:  $r = .25, p = .004$ ), but was unrelated to such efficacy beliefs within the domain of

short-term self-control (TSC:  $r = .00, p = .98$ ) or long-term self-regulation (GRT:  $r = -.03, p = .73$ ). These findings suggest that individuals who endorse the mutual influence of mental and physical phenomena perceive themselves to be more capable of effective action, but suggest that this perception does not reliably generalize to actions concerned with self-regulatory effectiveness. As such, even though individuals with high self-efficacy report higher levels of self-control ( $r = .21, p = .24$ ) and grit ( $r = .43, p < .001$ ), high interactionists report high self-efficacy in the absence of corresponding efficacy towards self-control exertion. Such findings can perhaps be attributed to the fact that high interactionists are aware of the energy requirements for effective self-control (see above), thus causing them to be more cautious and/or realistic concerning their capability for this valuable category of individual outcomes.

### **Comparison of Predictive Validity**

A final concern of Study 1 was to explore the extent to which LI offers a potential improvement over extant measurements of metaphysical belief in predicting individual differences relevant to mind-body overlap. Given that LI and MPO are both theoretically designed to assess beliefs of mental-physical interactionism, I attempted to qualitatively compare the predictive validity of these measurements. Interestingly, LI was more robustly related to all but two individual differences under consideration in the present work (FII: MPO  $r = .26$ , LI  $r = .11$ ; CN: MPO  $r = .15$ , LI  $r = .15$ ). In other words, LI was more functional in predicting metrics relevant to interactionism, including metaphysical beliefs (MBD: MPO  $r = .19$ , LI  $r = .21$ ), experiential integration (PBC: MPO  $r = .17$ , LI  $r = .28$ ; PSC: MPO  $r = .16$ , LI  $r = .26$ ; PT: MPO  $r = .15$ , LI  $r = .27$ ), and self-control representations (SCE: MPO  $r = .13$ , LI  $r = .24$ ; SCSM: MPO  $r = .14$ , LI  $r = .25$ ). It

follows that LI may represent a more valid and comprehensive assessment of mind-body interactionism than MPO; the former of which relies upon a single-item figural assessment to represent a highly complex set of personal beliefs.

### **Discussion**

The data from Study 1 offer several conclusions about the nature of LI. For one, the moderate reliability of this metric suggests that LI may be a relatively stable individual difference measure capable of encapsulating one's beliefs regarding mental-physical overlap. Given the relevance of such beliefs within important human domains (e.g., health practices - Forstmann et al., 2012; perspective-taking - Forstmann et al., under review), it follows that including LI within future investigations of social-psychological phenomena is warranted. Furthermore, because LI correlates with other empirically-validated measures of perceived mental-physical overlap (i.e., MPO - Forstmann et al., 2012, MBD - Preston et al., 2013), and predicts individual differences related to this overlap more effectively than do these extant measures (see Table 1), it stands to reason that LI is both ecologically valid and practically functional as an assessment of mental-physical beliefs. Given that metaphysical beliefs are highly complex and multifaceted, this multi-item cognitive assessment of LI appears to offer a useful medium between a simplistic figural assessment (Forstmann et al., 2012) and a complex philosophical battery (Preston et al., 2013). As such, I chose to retain this assessment as my measure of interactionist beliefs within subsequent studies.

In addition to establishing its relationship with extant measures of metaphysical beliefs, Study 1 offers an assessment of how LI correlates with individual differences both relevant and irrelevant to mind-body overlap. For one, LI correlated strongly with

several individual differences associated with an awareness of ongoing psychological and physiological states (i.e., PBC, PSC). Second, LI correlated moderately with several individual differences associated with successful cognitive and behavioral performance (i.e., ASCW, WRK, NFC). Third, LI was negatively associated with SH, an individual difference predictive of intentionally undermining one's performance in ego-threatening contexts. Finally, LI was not associated with general personality variables (i.e., Big Five), nor was it correlated with general spiritual beliefs (i.e., religiosity).

Taken together, the results of Study 1 suggest that LI is (1) psychometrically reliable, (2) predictive of individual differences relevant to mental-physical overlap, (3) related to particular markers of effective self-regulation, and (4) orthogonal to general measures of personality and spirituality. The remaining studies attempt to utilize this index to assess the extent to which lay interactionism influences perceptual, cognitive, and behavioral indices within particular self-control contexts. In particular, Studies 2-4 examine the extent to which LI, along with experimental manipulations of mental/physical primes, independently and interactively predict self-control exertion within classic self-control paradigms, including handgrip persistence (Study 2), cold pressor performance (Study 3), and Stroop interference (Study 4).

## **Study 2**

To begin exploring the independent and interactive influences of LI and mental/physical framing, Study 2 employed a conventional self-control persistence task: handgrip exertion (e.g., Egan et al., 2012; Martijn et al., 2003; Muraven et al., 1998). This handgrip exertion task was performed while participants were attached to an ostensibly functional electrophysiological measurement machine. To manipulate the

metaphysical framing of this task, participants were attached to the measurement machine via electrodes adhered to their temples (mental condition) or their biceps (physical condition). Based on a previous pilot study (see Appendix 1, Study 2), I anticipated that individuals with electrodes attached to their temples (biceps) would be more likely to perceive this handgrip task as mental (physical) in nature, would show greater (lesser) overall persistence on the task. Furthermore, given that the electrode manipulation was intended to alter participants' subjective responses to the task, I predicted that any effect of the electrode manipulation on handgrip persistence would be mediated by subjective responses related to the self (i.e., pain) and/or the task (i.e., task perceptions). Control participants, who did not have electrodes attached to their temples or biceps during the task, were included for comparison purposes.

In addition to manipulating the attachment of electrodes to influence the task's mental/physical framing, participants completed an index of LI prior to the experimental protocol. As mentioned in the introduction, I predicted an interaction between the framing manipulation and LI, such that the main effect of the framing manipulation would be most (least) pronounced among low (high) LI participants. That is, because lower levels of LI correspond with an increased tendency to dichotomize phenomena into separate mental and physical components, low (high) LI participants should be more likely to focus exclusively on the nature of the handgrip task implied by the electrode attachment.

## **Method**

### **Participants**

123 Indiana University undergraduates (85 female) participated for partial course credit. Participants were randomly assigned to one of three conditions (*mental* - electrodes on temples; *physical* - electrodes on biceps; *control* - no electrodes).

## **Procedure**

*Pre-Study Survey.* As part of a larger survey session, participants completed a variety of demographic and individual difference measurements relevant to the present work. Upon completing this survey, participants were recruited to participate in a subsequent experimental session 2 to 4 weeks later.

*Experiment Introduction.* Participants were invited to participate in an experiment titled “Studying the Senses”. Upon obtaining consent, participants were escorted to an individual laboratory cubicle, in which they read a brief description of the studies they would be completing in the present protocol. Upon reading this information, participants were asked to exit the cubicle and contact the experimenter in order to continue with the study. At this point, the experimenter intercepted the participant and escorted him/her to a separate cubicle within the laboratory that contained the equipment for handgrip assessment.

*Handgrip Maximum Exertion Task.* After both the participant and experimenter were seated within this cubicle, the experimenter began to explain the purpose of the next portion of the experiment, which was to obtain a measurement of the participant’s maximum handgrip exertion from their dominant hand. Specifically, the experimenter explained that part of the purpose of the present study was to assess the overall handgrip ability of their dominant hand using the equipment within the cubicle. The experimenter then referred the participant to the computer screen, which showed a simple graphical

interface with time on the x-axis and handgrip force on the y-axis. It was explained that this interface would show the force expended on the handgrip device in real-time, and that it was the participant's task to maximize their handgrip force output during a series of 10-sec trials.

These trials were explained in great detail in order to prevent any confusion on the part of the participant. Specifically, the experimenter applied hand sanitizer to their hands, picked up the handgrip, explained the proper technique of holding the grip, the proper posture in which to complete the task, and the overall trajectory of performance that the participant should obtain when attempting the task for themselves. It was explained that participants should attempt to slowly build up their performance across the trial, such that they increased the amount of force exerted on the grip during the first five seconds of the trial, and then they began to squeeze the grip as hard as they possibly could during the second five seconds of the trial (adapted from Egan, Riley, Hirt, Eckert, & Koceja, 2014).

After explaining the task and ensuring the participant had no questions or concerns, the experimenter handed the grip to the participant, and asked if they were ready to begin. After a confirmatory response, the experimenter counted "three-two-one-start", and the participant began the first trial. During each trial, the experimenter provided verbal feedback attempting to motivate the participant to truly maximize their performance. Specifically, during the first half of the trial, the participant was told to continue increasing their performance (e.g., "Keep going!", "Keep building up!", "Higher, higher!") with increasing verbal intensity, and during the second half of the trial, the participant was told to maximize their performance (e.g., "Squeeze as hard as you



can!", "Maximize!", "Keep it up!") with high verbal intensity. After each trial, participants were provided with positive feedback (e.g., "Excellent work", "Great job", etc), unless the trial was inadequately performed, in which case the data was deleted and reattempted after clarifying the underlying problem. Participants were provided with a 10-sec break between each trial. Once two successful trials were performed, the participant was thanked and informed that he/she should return to their original cubicle from the start of the experiment to answer some questions about themselves.

*Handgrip Intermission.* Within the original cubicle, the computer program had automatically transitioned to the next portion of the experiment, which was comprised of a series of questions concerning participants' overall mood and subjective mental depletion (see Appendix 2). Upon completing these questions, participants were again asked to contact the experimenter outside the cubicle in order to begin a different part of the experiment. As before, the experimenter intercepted the participant when he/she exited the cubicle, and escorted him/her to the cubicle containing the handgrip equipment.

*Handgrip Persistence Task.* While the participant had been completing the subjective measurements within their original cubicle, the experimenter had altered the equipment present in the handgrip cubicle, such that participants now saw a different computer program on the screen and some additional physical materials (e.g., alcohol swabs, electrode pads, a pain assessment scale; see Appendix 3). After both the participant and experimenter were seated, the experimenter began to provide instructions concerning the nature of the next task. Specifically, the participant was informed that

they would now be completing a handgrip persistence task based on the responses they provided in their previous maximum exertion task.

This handgrip persistence task was again described in great detail in order to prevent any confusion on the participant's part. For one, the experimenter explained the graphical interface of this persistence task, such that dark gray line across the y-axis represented their performance threshold for this task; a threshold that the participant would need to exceed for the duration of the persistence task. Specifically, the participant was told that this threshold was a percentage of their overall maximum exertion (i.e., 40%), and that their job was to keep their performance slightly above this line for as long as possible. The participant was further informed that this task would become increasingly difficult over time, such that their performance would eventually fall below this line at some point during the task. In this case, the participant was asked to recover their performance above the line as quickly as possible, and to engage in such recovery during every below-line instance. Finally, the participant was informed that they should continue performing this task until they were no longer able to recover their performance above the line, at which point the task would be complete (Egan, Riley, Hirt, Eckert, & Koceja, 2014).

After explaining the structure of the persistence task, the experimenter referred participants to the sheet of paper on the desk in front of them, which represented the subjective pain scale utilized in the present experiment (see Appendix 4). The participant was informed that this scale would be used to assess their subjective level of pain throughout the experiment at 20-sec intervals. Participants were asked to carefully read over the scale, and to imagine what particular levels of subjective pain (i.e., 1, 5, 10)

would feel like according to their own interpretation. The experimenter asked participants to get comfortable with this scale, such that they would be able to quickly and accurately report their subjective pain during the task without losing focus on the persistence task.

After clarifying the pain scale, the experimenter further explained that in addition to their handgrip performance and subjective pain assessments, the lab would be collecting electrical activity from their brain/arm during this task via the use of an EEG/EMG machine.<sup>3</sup> Specifically, participants were informed that electrodes would be attached to their temples/biceps to measure the electrical activity from their brain/arm while they completed the persistence task. The experimenter explained that these electrodes were attached to the machine located on the desk, and that this machine would transmit their electrical activity to the computer for further analysis. Upon obtaining their verbal consent for collecting this data (no participant refused), participants were asked to use an unopened alcohol swab to clean either their temples or biceps, such that the electrodes could be attached properly. Participants with long hair were provided with hair ties, and participants wearing coats and jackets were asked to remove these in the case of bicep attachment. Upon cleaning the targeted area (established via experimenter instruction), the experimenter carefully attached an electrode to each temple (i.e., approximately one inch above and outside the lateral end of each eye) or each bicep (i.e., approximately two inches above the inside of each elbow).

The experimenter then informed the participant that the EEG/EMG machine would now be turned on to begin collecting data. To reinforce the cover story, participants were informed that they might experience a slight tingling sensation when the machine is activated, but that this sensation would quickly dissipate after a few

seconds. Finally, the experimenter turned on the machine, and adjusted the volume to a predesignated set point, such that the machine began to emit a low humming noise.

Although the machine was functionally useless as an EEG/EMG machine (i.e., it was actually a radio transmitter), no participants reported any suspicion concerning its validity.

After this electrode attachment procedure, the experimenter reinforced the instructions for the task (i.e., persistence, pain assessment, hand position, body posture), and asked the participant if he/she was ready to begin. As with the maximum exertion task, participants were provided with a “3-2-1-start” countdown, at which point they began. In addition to assessing pain and recording these values throughout the task, the experimenter also provided encouragement by using several scripted phrases according to current performance (adequate performance: “Good job!”, “Keep holding the line!”, “Excellent!”; inadequate performance: “Keep going!” “Don’t fall below the line!”, “Get back above the line!”). When the participant’s performance was no longer able to recover above the threshold, the experimenter thanked the participant for their effort, and then turned off the EEG/EMG machine, removed the electrodes, and asked the participant to return to his/her original cubicle to complete the remainder of the experiment.

*Experiment Completion.* Within the original cubicle, the computer program had automatically transitioned to the next portion of the experiment, which was comprised of a series of questions concerning their perceptions and motivations towards the persistence task. Upon completing these questions, participants were fully debriefed concerning the nature of the study, and were allowed to leave the laboratory.

## **Measures**

As in Study 1, the measures used in the present study are described briefly in the main text. However, the exact wordings and scales used for each measurement can be found in Appendix 2.

*Demographic Information.* At the outset of the experimental procedure, participants reported their age and gender.

*Individual Differences.* Prior to the present experiment, participants completed a series of individual difference items as part of a larger survey session. Of interest to the present work were items concerning LI, LTW, TSC, and MPO.

*Handgrip Maximum Exertion.* Maximum exertion data was retained using Vernier Human Physiology software, which consisted of an electronic handgrip dynamometer attached to the desktop computer via a USB cable. The software allows for the dynamic representation of handgrip data on the computer screen, such that participant force output is measured four times per second. All data was saved in electronic spreadsheets as a function of trial, which were then analyzed at the completion of the experiment. For each successful trial, maximum exertion was obtained by assessing the highest force measurement, taken to the nearest digit. To ensure a reliable measure of maximum exertion, the maximum point for two successful trials were averaged to form the maximum exertion metric.

*Mood.* For one, participants were asked to report their overall mood using a series of semantic differential scales. Specifically, participants reported the extent to which they were feeling particular emotional states on a series of semantic differential scales, such as 1(*Very bad*) to 9(*Very good*). In addition participants were asked to report their perceived mental depletion using a conventional set of four items (e.g., How mentally exhausted do

you now feel?; see Clarkson et al., 2010; 2011), each of which was provided on a scale ranging from 1(*Not at all*) to 9(*Very much*). Surprisingly, the indices for perceived mental depletion and mood combined to form a reliable metric of overall participant mood ( $\alpha = .77$ ), with higher scores indicating more positive emotions and greater mental energy.

*Handgrip Persistence.* Given the large amount of data produced by the handgrip software, caution was taken to select the most meaningful metric of self-control persistence. At a basic level, overall persistence on this task can be inferred via the amount of time participants spend before being unable to recover above their set threshold (i.e., total time). However, because this persistence metric is qualified by both the overall amount of force required (i.e., the participant's overall strength) and the amount of time participants fell below the line during the task (i.e., the participant's overall performance), I included both maximum handgrip exertion and performance quality as covariates to this total time metric.

*Perceived Pain.* As with the handgrip performance data, the multiple pain measurements taken throughout the handgrip task necessitated my selection of a meaningful and interpretable pain metric. Among the metrics available (e.g., pain level immediately prior to task failure, overall pain range), the primary metric of subjective pain I selected was *pain slope*. From a theoretical perspective, pain slope represents the rate at which subjective pain rises as a function of time, such that lower pain slopes represent a greater ability to overcome, ignore, and/or misrepresent markers of psychological and physiological discomfort.<sup>4</sup> Pain slope was calculated by dividing the range of perceived pain (i.e., final pain report - initial pain report) by total time on the

task, such that lower scores represent an decreased sensitivity to the pain elicited by the persistence task.

*Motivation.* In line with previous research (Muraven & Slessareva, 2003; Muraven et al., 2006), I included assessments of participant's overall motivation toward the handgrip task, both in a retrospective sense (2 items; e.g., "How motivated were you to work hard on the handgrip persistence task?") and a prospective sense (1 item; "How willing would you be to complete another handgrip persistence task later in the experiment?").

*Handgrip Task Thoughts.* Immediately following the persistence task, participants completed an open-ended thought-listing protocol concerning their experience with the task. Specifically, they listed the first 3 to 4 thoughts that came to mind when considering the handgrip persistence procedure. The data from this thought-listing task was provided to four independent coders (i.e., research assistants within the laboratory), who assessed the extent to which each participant's response listed terms referring to mental processes (e.g., brain processes, self-control, willpower), physical processes (e.g., arm/hand sensations, grip force, muscle use), fatigue (e.g., stamina, exhaustion, mental tiredness), and difficulty (e.g., pain, challenge). Inter-rater reliability was promoted via the coders discussing ten randomly selected participant responses, after which point each coder completed the remainder of participant responses independently. Results indicated good reliability (mental,  $\alpha = .89$ ; physical,  $\alpha = .82$ ; difficulty,  $\alpha = .83$ ; fatigue,  $\alpha = .86$ ), allowing ratings to be averaged across coders to form separate indices of mental terms, physical terms, fatigue terms, and difficulty terms among each participant.

*Handgrip Task Perceptions.* Participants were asked several questions concerning their perceptions of the handgrip task, including task difficulty (2 items; e.g., “Overall, how difficult did you find the handgrip persistence task to be?”), mental task perceptions (3 items; e.g., “To what extent do you think the handgrip task is a test of your willpower?”), physical task perceptions (2 items; e.g., “To what extent do you think the handgrip task is a test of your physical abilities?”), and mental-versus-physical task perceptions (1 item; “Do you think the handgrip task is more of a mental challenge, or a physical challenge?”). As with the self-report items discussed previously, the exact wordings and scales used for these indices can be found in Appendix 2.

*Electrode Attachment Perceptions.* To account for potential differences in the perceived validity of electrodes placed at the temples versus the biceps, participants in the physical and mental conditions were asked one additional question concerning their impression of the electrode attachment procedure. Specifically, they were asked to indicate the extent to which they thought the electrodes attached to them during the persistence task represented a viable experimental measurement (“How accurate do you believe the electrical measurements taken during this task were?”).

## **Results**

Unless otherwise noted, all analyses tested the effect of condition ( $-1 = \text{Physical}$ ,  $+1 = \text{Mental}$ ), lay interactionism (mean-centered), and their interaction term on the dependent measure of interest. These effects were tested via moderated linear regression, with potential covariates assessed in an initial block (i.e., mood, participant gender, maximum exertion), main effects assessed in a secondary block (i.e., experimental



condition, LI), and the Condition x LI interaction assessed in a final block. All results and summary statistics are provided in Tables 2-4.

### **Handgrip Persistence**

The primary dependent measure of interest was how long participants kept their performance above the threshold before being unable to continue. In addition to mood, gender, and maximum persistence, the handgrip persistence data included one other covariate of interest, which was time spent below the line (broken into time spent 5%, 10%, 15% and 50% below). This covariate was included to isolate self-regulatory persistence from inherent differences in overall persistence quality (i.e., temporary performance below the threshold decreases muscular fatigue).

The primary block was significant,  $F(7, 73) = 2.13, p = .05$ . Results indicated no effect of participant mood ( $\beta = .10, t(73) = 0.85, p = .40$ ), participant gender ( $\beta = .00, t(73) = -0.01, p = .99$ ), maximum exertion ( $\beta = -.19, t(73) = -1.04, p = .30$ ), or time 50% below the line ( $\beta = -.14, t(73) = -0.73, p = .46$ ). However, there were several significant effects of time spent below the line, with a positive effect for time spent 5% below the line ( $\beta = 1.13, t(73) = 3.09, p = .003$ ), a negative effect for time spent 10% below the line ( $\beta = -3.28, t(73) = -2.84, p = .01$ ), and a positive effect for time spent 15% below the line ( $\beta = 2.17, t(73) = 2.24, p = .03$ ). Interestingly, inconsistencies in the direction of these effects suggest that falling below the performance threshold during the persistence task can predict both poorer performance (e.g., by serving as an indicator of lower overall task ability) and better performance (e.g., by allowing participants to engage in periods of minor rest during the task) depending on the level at which these performance drops are observed. While speculative, these data imply that slight and extreme decrements in

performance may have allowed for performance recovery, whereas moderate decrements in quality represented an indicator of impending failure.

The secondary block was also significant,  $F(9, 71) = 2.24, p = .03$ . Results indicated no effect of LI ( $\beta = .05, t(71) = 0.46, p = .65$ ). However, there was a significant effect of condition ( $\beta = .22, t(71) = 1.95, p = .05$ ), such that as the manipulation shifted from electrodes on the biceps to electrodes on the temples, persistence was significantly higher. To explore this effect further, post-hoc analyses were conducted comparing the persistence of individual conditions. For one, both the physical and mental conditions were found to differ from the neutral control condition. That is, participants in the physical condition persisted marginally longer than did participants in the neutral condition ( $t(81) = 1.81, p = .07$ ), and participants in the mental condition persisted significantly longer than did participants in the neutral condition ( $t(80) = 4.15, p < .001$ ). Both of these effects may reflect increased task motivation when participants were attached to electrode equipment, such that the presence of additional experimental materials and ostensible measures increased the psychological realism of the procedure. Additional post-hoc comparisons showed that participants in the physical and mental conditions differed significantly from one another. That is, participants in the mental condition persisted significantly longer than did participants in the physical condition ( $t(81) = -2.21, p = .03$ ). Taken together then, the effect of condition on persistence suggests a linear pattern, such that persistence was lowest in the neutral condition, highest in the mental condition, and moderate in the physical condition (see Figure 1).

The final block was also significant,  $F(10, 70) = 1.99, p = .05$ , but indicated no interaction between condition and LI ( $\beta = .00, t(70) = -0.01, p = .99$ ). As such, the

significant effect of condition described in the previous paragraph emerged irrespective of one's level of LI.

### **Perceived Pain**

The present study's primary metric of perceived pain was pain slope, which was calculated by dividing the overall range of each participant's pain report by the amount of time spent on the task. The primary block assessing pain slope was not significant,  $F(3, 77) = 0.45, p = .72$ , and indicated no effect of participant mood ( $\beta = .07, t(77) = 0.55, p = .58$ ), participant gender ( $\beta = .07, t(77) = 0.40, p = .69$ ), or maximum exertion ( $\beta = .03, t(77) = 0.16, p = .87$ ).

The secondary block was also not significant,  $F(5, 75) = 1.73, p = .14$ . Results indicated no effect of LI ( $\beta = .18, t(75) = 1.50, p = .14$ ), but consistent with the persistence data, there was a significant effect of condition ( $\beta = -.28, t(75) = -2.48, p = .02$ ). Specifically, as the manipulation shifted from electrodes on the biceps to electrodes on the temples, pain slope was significantly lower. To explore this effect further, post-hoc analyses were conducted comparing the pain slopes of individual conditions. Unlike the persistence data, the physical and neutral conditions were not found to differ from one another ( $t(81) = 0.09, p = .93$ ). However, in line with the persistence data, participants in the mental condition differed from both the physical and neutral conditions, such that the pain slope within the mental condition was marginally lower than that of the neutral condition ( $t(80) = -1.85, p = .07$ ), and was significantly lower than that of the physical condition ( $t(79) = 2.03, p = .05$ ). Taken together, these effects suggests a two-tiered pattern, such that pain slope was lowest in the mental condition, and relatively higher in both the physical and neutral conditions.

The final block was not significant,  $F(6, 74) = 1.45, p = .21$ , and indicated no interaction between condition and LI ( $\beta = .04, t(74) = 0.33, p = .74$ ), which again suggests that the effect of condition emerged irrespective of one's level of LI.

### **Handgrip Task Perceptions**

There were four metrics of handgrip task perceptions employed in the present study: mental task perceptions (i.e., extent to which the task involves the operation of mental faculties), physical task perceptions (i.e., extent to which the task involves the operation of physical faculties), mental-versus-physical task perceptions (i.e., the extent to which the task involves a relative majority of mental or physical faculties), and task difficulty perceptions (i.e., the subjective experience of difficulty encountered throughout the task). I outline the results for each of these metrics below.

*Mental Task Perceptions.* The primary block assessing mental task perceptions was not significant,  $F(3, 77) = 1.57, p = .20$ . Results indicated no effect of participant mood ( $\beta = .13, t(77) = 1.13, p = .26$ ), no effect of maximum exertion ( $\beta = -.18, t(77) = -0.98, p = .33$ ), and a marginal effect of participant gender ( $\beta = .31, t(77) = 1.69, p = .10$ ). This latter effect suggests that female participants were slightly more likely to think about the handgrip task's mental nature. The secondary block was also not significant,  $F(5, 75) = 1.47, p = .21$ , and indicated no effect of LI ( $\beta = .18, t(75) = 1.55, p = .13$ ) and no effect of condition ( $\beta = -.09, t(75) = -0.75, p = .45$ ). The final block was significant,  $F(6, 74) = 2.93, p = .01$ , and showed a highly significant interaction between condition and LI ( $\beta = -.32, t(74) = -3.07, p = .003$ ).

To explore this interaction further, I conducted a simple slopes analysis in which the effect of condition was examined at high (+1 SD), medium (0 SD), and low (-1 SD)

levels of LI. At high levels of LI, there was a significant negative effect of condition, such that as the electrode attachment moved from the biceps to the temples, participants reported lower mental task perceptions ( $\beta = -.34$ ,  $t(74) = -2.66$ ,  $p = .01$ ). At medium levels of LI, there was no effect of condition ( $\beta = -.06$ ,  $t(74) = -0.68$ ,  $p = .50$ ). At low levels of LI, there was a marginal positive effect of condition, such that as the electrode attachment moved from the biceps to the temples, participants reported higher mental task perceptions ( $\beta = .22$ ,  $t(74) = 1.70$ ,  $p = .09$ ).

Consistent with predictions, these data suggest that the influence of metaphysical framing is contingent upon individual differences in LI. For those who perceived high overlap between mental and physical processes, the electrode placement seemed to activate thoughts concerning the opposing process, such that high interactionists perceived the handgrip task as more mentally (physical) involving when electrodes were attached to their arms (temples). In contrast, for those who perceived low overlap between mental and physical processes, the electrode placement seemed to activate thoughts concerning the primary process, such that low interactionists tended to perceive the handgrip task as more mentally (physically) involving when electrodes were attached to their temples (biceps).

*Physical Task Perceptions.* The primary block assessing physical task perceptions was not significant,  $F(3, 77) = 0.70$ ,  $p = .55$ , and indicated no effect of participant mood ( $\beta = .03$ ,  $t(77) = 0.29$ ,  $p = .78$ ), participant gender ( $\beta = -.06$ ,  $t(77) = -0.34$ ,  $p = .73$ ), or maximum exertion ( $\beta = -.12$ ,  $t(77) = -0.61$ ,  $p = .54$ ). The secondary block was not significant,  $F(5, 75) = 0.48$ ,  $p = .79$ , and showed no effect of condition ( $\beta = -.06$ ,  $t(75) = -0.50$ ,  $p = .62$ ) or LI ( $\beta = -.03$ ,  $t(75) = -0.20$ ,  $p = .84$ ). The final block was also not

significant,  $F(6, 74) = 0.41, p = .87$ , and indicated no interaction between condition and LI ( $\beta = .04, t(74) = 0.30, p = .77$ ). Thus, in contrast to the mental task perception data (see above), neither the electrode manipulation nor LI showed any ability to predict one's perceptions about the physical nature of the handgrip persistence task. Rather, all participants perceived the task as relatively physically involving (i.e., the grand mean of 6.60 was significantly above the scalar midpoint of 5.00,  $t(122) = 14.04, p < .001$ ).

*Overall Task Perceptions.* The primary block assessing overall task perceptions was significant,  $F(3, 77) = 2.85, p = .04$ . Although there were no effects of either participant gender ( $\beta = -.25, t(77) = -1.41, p = .16$ ), or maximum exertion ( $\beta = .24, t(77) = 1.31, p = .19$ ), results indicated a significant effect of participant mood ( $\beta = -.29, t(77) = -2.59, p = .01$ ). Specifically, a more positive mood was associated with a higher perception of the handgrip task as mentally (rather than physically) involving.

The secondary block was significant,  $F(5, 75) = 2.88, p = .02$ . Contrary to predictions, results indicated no effect of condition ( $\beta = .14, t(75) = 1.25, p = .21$ ), such that the task was perceived in a similar manner irrespective of electrode attachment condition. However, consistent with the mental task perception data, there was a significant effect of LI ( $\beta = -.25, t(75) = -2.18, p = .03$ ), such that higher LI scores corresponded with higher perceptions of the task as mentally (rather than physically) involving. Thus, although all participants tended to perceive the handgrip task as more mentally than physically involving overall (i.e., the grand mean of 4.61 was significantly below the scalar midpoint of 5.00,  $t(122) = -2.56, p = .01$ ), participants who endorsed a stronger (weaker) overlap between physical and mental phenomena were increasingly likely to emphasize the mental (physical) involvement elicited by the task.

The final block was also significant,  $F(6, 74) = 3.61, p = .003$ , and indicated a significant interaction between condition and LI ( $\beta = .26, t(74) = 2.50, p = .02$ ). To explore this interaction further, I again conducted a simple slopes analysis. At high levels of LI, there was a significant positive effect of condition, such that as the electrode attachment moved from the biceps to the temples, participants reported task perceptions in the physical (rather than mental) direction ( $\beta = .30, t(74) = 2.40, p = .02$ ). However, at medium ( $\beta = .10, t(74) = 1.10, p = .28$ ) and low ( $\beta = -.11, t(74) = -0.87, p = .39$ ) levels of LI, there was no effect of condition. While less robust, these data partially replicate the mental task perception data, such that high interactionists were more likely perceive the handgrip task in a manner that conflicted with the implied processes of the electrode attachment. Specifically, high interactionists perceived the task as more physically involving when electrodes were attached to their temples, whereas low interactionists were relatively unaffected by the electrode attachment in terms of their perceptual response.

*Task Difficulty.* The primary block assessing subjective task difficulty was not significant,  $F(3, 77) = 1.78, p = .16$ , and indicated no effect of participant mood ( $\beta = .06, t(77) = 0.53, p = .60$ ), participant gender ( $\beta = .26, t(77) = 1.44, p = .16$ ), but did indicate a significant effect of maximum exertion ( $\beta = -.42, t(77) = -2.25, p = .03$ ), such that higher initial handgrip exertion was positively associated with perceptions of difficulty on the subsequent persistence task. The secondary block not significant,  $F(5, 75) = 1.51, p = .20$ , and indicated no effect of condition ( $\beta = -.15, t(75) = -1.33, p = .19$ ), or LI ( $\beta = -.04, t(75) = -0.36, p = .72$ ). The final block was again not significant,  $F(6, 74) = 1.62, p = .15$ , and indicated no interaction between condition and LI ( $\beta = -.16, t(74) = -1.44, p = .15$ ).

## Motivation

There were two metrics of motivation employed in the present study: retrospective motivation (i.e., extent to which participant reported working hard on the handgrip task), and prospective motivation (i.e., extent to which the participant reported a willingness to complete another handgrip task later in the experiment).

*Retrospective Motivation.* The primary block assessing retrospective motivation was not significant,  $F(3, 77) = 0.28, p = .84$ . Results indicated no effect of participant mood ( $\beta = .05, t(77) = 0.43, p = .67$ ), maximum exertion ( $\beta = -.03, t(77) = -0.13, p = .90$ ), or participant gender ( $\beta = -.08, t(77) = -0.45, p = .66$ ). The secondary block was not significant,  $F(5, 75) = 0.26, p = .93$ , and indicated no effect of condition ( $\beta = -.02, t(75) = -0.16, p = .87$ ) or LI ( $\beta = .09, t(75) = 0.71, p = .48$ ). The final block was also not significant,  $F(6, 74) = 0.35, p = .91$ , and showed no interaction between condition and LI ( $\beta = -.10, t(74) = -0.90, p = .37$ ).

*Prospective Motivation.* The primary block assessing prospective motivation was not significant,  $F(3, 77) = 0.21, p = .85$ , and indicated no effect of participant mood ( $\beta = -.06, t(77) = -0.52, p = .60$ ), participant gender ( $\beta = .11, t(77) = 0.57, p = .57$ ), or maximum exertion ( $\beta = -.08, t(77) = -0.39, p = .70$ ). The secondary block was not significant,  $F(5, 75) = 0.22, p = .95$ , and indicated no effect of condition ( $\beta = -.07, t(75) = -0.57, p = .57$ ) or LI ( $\beta = .06, t(75) = 0.50, p = .62$ ). The final block was also not significant,  $F(6, 74) = 0.24, p = .96$ , and showed no interaction between condition and LI ( $\beta = .07, t(74) = 0.57, p = .57$ ).

## Handgrip Task Thoughts



There were four metrics concerning the open-ended responses participants provided following the handgrip persistence task. Specifically, these responses were coded in terms of the extent to which they referenced mental thoughts, physical thoughts, difficulty thoughts, and fatigue thoughts.

*Mental Thoughts.* The primary block assessing mental thoughts was significant,  $F(3, 77) = 3.52, p = .02$ . Results indicated no effect of participant gender ( $\beta = .08, t(77) = 0.44, p = .66$ ), no effect of maximum exertion ( $\beta = .16, t(77) = 0.92, p = .36$ ), and a marginal effect of participant mood ( $\beta = .21, t(77) = 1.83, p = .07$ ). This latter effect suggests that female participants were slightly more likely to think about the handgrip task's mental nature, a result paralleling the mental task perception findings described previously. The secondary block was also significant,  $F(5, 75) = 3.16, p = .01$ , and indicated no effect of LI ( $\beta = .15, t(75) = 1.34, p = .19$ ) and no effect of condition ( $\beta = -.16, t(75) = -1.45, p = .15$ ). The final block was significant,  $F(6, 74) = 2.63, p = .02$ , but showed no interaction between condition and LI ( $\beta = .04, t(74) = 0.37, p = .71$ ).

*Physical Thoughts.* The primary block assessing physical thoughts was not significant,  $F(3, 77) = 0.38, p = .77$ . Results indicated no effect of participant mood ( $\beta = -.10, t(77) = -0.80, p = .43$ ), participant gender ( $\beta = -.07, t(77) = -0.39, p = .70$ ), or maximum exertion ( $\beta = .15, t(77) = 0.81, p = .42$ ). The secondary block was not significant,  $F(5, 75) = 1.34, p = .26$ , and indicated no effect of LI ( $\beta = .13, t(75) = 1.11, p = .27$ ), but did indicate a significant effect of condition ( $\beta = -.26, t(75) = -2.24, p = .03$ ). This latter effect shows that as the electrode manipulation moved from the biceps to the temples, participants were less likely to think about the task's physical nature. To explore this effect in more detail, I conducted post-hoc comparisons of physical thoughts as a

function of experimental condition. Results showed that participants in the mental condition ( $M = 1.44$ ,  $SD = 0.79$ ) reported significantly less physical thoughts about the task than did participants in the physical condition ( $M = 1.82$ ,  $SD = 0.80$ ),  $t(79) = 2.15$ ,  $p = .03$ . As with mental thoughts (see above), these results support the efficacy of the experimental manipulation. No other differences between conditions were statistically reliable. The final block was not significant,  $F(6, 74) = 1.12$ ,  $p = .36$ , and showed no interaction between condition and LI ( $\beta = .04$ ,  $t(74) = 0.34$ ,  $p = .73$ ).

*Difficulty Thoughts.* The primary block assessing difficulty thoughts was not significant,  $F(3, 77) = 0.39$ ,  $p = .76$ , and indicated no effect of participant mood ( $\beta = .11$ ,  $t(77) = 0.89$ ,  $p = .38$ ), participant gender ( $\beta = .05$ ,  $t(77) = 0.29$ ,  $p = .77$ ), or maximum exertion ( $\beta = -.14$ ,  $t(77) = -0.72$ ,  $p = .47$ ). The secondary block was not significant,  $F(5, 75) = 0.45$ ,  $p = .81$ , and indicated no effect of LI ( $\beta = -.12$ ,  $t(75) = 0.99$ ,  $p = .33$ ) or condition ( $\beta = .06$ ,  $t(75) = 0.54$ ,  $p = .59$ ). The final block was again not significant,  $F(6, 74) = 0.56$ ,  $p = .76$ , and showed no interaction between condition and LI ( $\beta = -.12$ ,  $t(74) = -1.05$ ,  $p = .30$ ).

*Fatigue Thoughts.* The primary block assessing fatigue thoughts was not significant,  $F(3, 77) = 0.73$ ,  $p = .54$ , and indicated no effect of participant mood ( $\beta = .01$ ,  $t(77) = 0.06$ ,  $p = .96$ ), participant gender ( $\beta = .04$ ,  $t(77) = 0.21$ ,  $p = .84$ ), or maximum exertion ( $\beta = -.20$ ,  $t(77) = -1.04$ ,  $p = .30$ ). The secondary block was not significant,  $F(5, 75) = 0.55$ ,  $p = .74$ , and indicated no effect of LI ( $\beta = -.09$ ,  $t(75) = -0.72$ ,  $p = .48$ ) or condition ( $\beta = -.02$ ,  $t(75) = -0.20$ ,  $p = .85$ ). The final block was again not significant,  $F(6, 74) = 0.46$ ,  $p = .84$ , and showed no interaction between condition and LI ( $\beta = .00$ ,  $t(74) = 0.03$ ,  $p = .98$ ).

### **Electrode Attachment Perceptions**

To ensure that the electrode attachment manipulation was perceived as equally valid across the physical and mental conditions, I conducted a post-hoc regression analysis comparing perceived measurement validity across the physical and mental conditions. This analysis yielded no evidence that participant perceptions varied as a function of the electrode placement ( $\beta = -.12$ ,  $t(74) = -1.02$ ,  $p = .31$ ), implying that any differences between the physical and mental conditions were not driven by perceptions of measurement validity. There were also no effects of mood ( $\beta = .06$ ,  $t(76) = 0.48$ ,  $p = .63$ ), participant gender ( $\beta = -.12$ ,  $t(76) = -0.66$ ,  $p = .51$ ), maximum exertion ( $\beta = .04$ ,  $t(76) = 0.18$ ,  $p = .86$ ), LI ( $\beta = .15$ ,  $t(74) = 1.26$ ,  $p = .21$ ), or LI x Condition interaction ( $\beta = -.11$ ,  $t(73) = -0.99$ ,  $p = .33$ ) on this perceptual metric.

### **Mediation of Persistence via Subjective Pain**

Given the parallel effects of condition on both pain slope and handgrip persistence, I conducted an exploratory mediational analysis assessing the extent to which changes in pain slope explained the relationship between condition and persistence (see Figure 2). As mentioned previously, condition ( $-1 = \text{Physical}$ ,  $1 = \text{Mental}$ ) positively predicted handgrip persistence ( $\beta = .24$ ,  $t(75) = 2.11$ ,  $p = .04$ ), and negatively predicted pain slope ( $\beta = -.28$ ,  $t(75) = -2.48$ ,  $p = .02$ ). In addition, pain slope strongly predicted handgrip persistence ( $\beta = -.41$ ,  $t(117) = -4.99$ ,  $p < .001$ ), such that lower pain slope corresponded to higher overall persistence. When including both condition and pain slope in a regression equation predicting handgrip persistence, the effect of pain slope remained significant ( $\beta = -.44$ ,  $t(116) = -4.16$ ,  $p < .001$ ), whereas the effect of condition became non-significant ( $\beta = .12$ ,  $t(116) = 1.09$ ,  $p = .28$ ). Post-hoc bootstrapping analyses showed

that the 95% confidence interval of the indirect effect did not include 0 (CI: 0.79 to 15.23), suggesting that pain slope mediated the influence of condition on handgrip persistence. Thus, participants in the mental (physical) condition exhibited higher (lower) handgrip persistence partially because their subjective pain ratings on the handgrip task rose less (more) severely over time.

### **Discussion**

Study 2 provides several intriguing patterns of findings. For one, the effect of the experimental manipulation on handgrip persistence suggests that there may be a self-regulatory benefit from contexts that emphasize the mental, rather than physical, nature of task performance. That is, participants with electrodes attached to their temples during a difficult handgrip task were able to persist substantially longer than were participants with electrodes attached to their biceps and participants with no electrodes attached at all. These findings emerged controlling for several other factors relevant to self-control performance on handgrip tasks, such as maximum force output, overall performance quality, and transient mood. In understanding this effect of electrode attachment, the mediational findings indicate that the manipulation altered participants' perceptions of pain during the persistence task, such that participants with electrodes attached to their temples reported a less rapid increase in pain throughout the task, thus causing such participants to persist longer on the task overall.

This mediational effect of pain on handgrip persistence is open to many possible interpretations, several of which I discuss below. For one, it could be that the electrode manipulation altered the conceptual meaning of "pain", such that participants with electrodes on their temples thought of pain in more abstract terms (e.g., mental fatigue,

concentration lapses) than did those with electrodes on their biceps (e.g., muscle fatigue, hand discomfort). As such, participants with electrodes attached to their temples may have been reporting on a qualitatively different construct than those with electrodes attached to their biceps, thus producing different patterns of pain over time. Alternatively, it is possible that participants in the different electrode conditions used different standards of comparison when considering their pain. For example, because priming mental constructs promotes a broader conceptual scope than does priming physical constructs (Trope & Liberman, 2010), those in the mental (physical) condition may have relied upon a broader (narrower) array of experiences when considering their ongoing experience of pain. It follows that a broader experience set could alter one's conception of particular points on the subjective pain scale (e.g., 1 = "Minimal Pain", 10 = "Excruciating Pain"), such that participants in the mental (physical) condition compared their handgrip experience to more (less) extreme past experiences, ultimately producing differences in subjective ratings in the absence of physiological differences in muscle exertion. Yet another possibility is that participants in the mental condition were more able to ignore the immediate sensations of pain that were inherent to effective task performance, such that having electrodes on one's temples (biceps) caused participants to employ a greater (fewer) number of mental strategies to obscure or delay the onset of pain. Regardless of the underlying explanation, the fact that subjective pain varied systematically across conditions suggests that the manipulation under study was effective in altering subjective responding in a manner directly predictive of self-control behavior.

In addition to finding that participants with electrodes attached to their temples reported less rapid pain acquisition and exhibited better behavioral persistence, the

present findings also showed that participants with electrodes attached to either their temples or their biceps outperformed participants with no electrodes attached during the task. That is, simply including an ostensible measurement of ongoing physiological responding was sufficient to increase participant persistence above that of a control group who were not attached to this measurement equipment. Such results are attributable to multiple factors inherent in more extensive experimental protocols, such as increased psychological realism, heightened task relevance, or norms of effort reciprocity. However, regardless of its origin, this pattern shares considerable overlap with research suggesting that direct physiological processes are perceived as superior to conceptual processes in explaining the same psychological phenomena (McCabe & Castel, 2008). As such, regardless of the mental or physical constructs invoked by the present procedure, this protocol appeared to focus participants on the underlying psychophysiological causes of their performance (i.e., neurons or muscle fibers), leading them to respond more effectively on the dependent measurement.

Aside from the effects of the experimental manipulation under study, there were also several intriguing findings concerning the role of lay interactionism (LI). Specifically, although LI did not predict behavioral or subjective responses *during* the persistence task, it did predict participants' subjective interpretations of the task *upon completion*. For one, high LI participants perceived the handgrip task as more mentally demanding than their low LI participants irrespective of experimental condition. While preliminary, this pattern of findings suggests that even though a handgrip task is generally regarded as equally physically and mentally involving (see task perception data), people who are prone to perceive the overlap between physical and mental

experience (i.e., high interactionists) are more likely to attend to the mental aspect of prolonged task exertion, whereas those who perceive less overlap between physical and mental experience (i.e., low interactionists) are more likely to attend to the physical aspect of this exertion. Given that task perceptions, especially those involving fatigue, have been shown to impact self-regulatory responding (Clarkson et al., 2010; 2011; Job et al., 2010; Muraven et al., 2008), it is prudent to include LI in future work on self-control persistence, especially when utilizing tasks with apparent involvement from both physiological and psychological sources.

In addition to a main effect of LI on task perceptions, the results also showed an interaction between LI and the framing manipulation. In particular, higher levels of LI predicted contrast to the intended direction of the electrode attachment manipulation, such that high LI participants perceived the task as *more* mentally involving when electrodes were attached to their biceps, whereas low LI participants perceived the task as *less* mentally involving when electrodes were attached to their biceps. Interestingly, these findings imply that high LI participants naturally invoke mental constructs when interpreting physiological responses, whereas low LI participants do not. Applied to the present context, high LI participants intuitively understood that their brain's responses on the handgrip task required analogous physical processes (e.g., subjective pain emerges via physiological fatigue). Upon considering the results of Studies 3 and 4, this issue is considered in greater depth within the General Discussion.

### **Study 3**

Given the promising findings offered in Study 2, Study 3 attempted to conceptually replicate this experimental design with a different manipulation of

physical/mental focus, as well as a different dependent measure of self-regulatory persistence. The experimental manipulation in Study 3 involved participants reading an op-ed article concerning the physical or mental challenges facing IU student-athletes. Given that sport is one domain in which physical and mental explanations for similar phenomena are relatively commonplace (Marcora, Stiano, & Manning, 2009), this manipulation utilizes identical challenges facing student-athletes (e.g., attending practice, travelling for competition), but explains their consequences in relatively physiological or psychological terms. Prior to implementation, the manipulation was pilot tested to ensure it influenced perceptions of effortful self-control tasks (see Appendix 2, Study 3). Upon completing this experimental manipulation, participants completed a conventional pain persistence assessment commonly used to index self-control known as the cold pressor task (CPT; McRae et al., 2006; Velasco, Gomez, Blanco, & Rodriguez, 1997). In a CPT, participants are asked to submerge their hand in a container of ice-cold water (i.e., 33-35° F), with self-regulatory effectiveness indexed by the amount of time the participant keeps his/her hand submerged in the face of increasing discomfort.

Paralleling the format of Study 2, Study 3 assessed individual differences prior to the completion of the main experimental protocol. In the main protocol, participants were randomly assigned to one of three conditions (i.e., mental - reading about the psychological challenges of student-athletes; physical - reading about the physiological challenges of student-athletes; control - reading about the neutral challenges of student-athletes). After completing the experimental manipulation, all participants completed the cold pressor task and a series of subjective measurements relevant to the self-regulatory assessment (i.e., task perceptions, motivation).



## **Method**

### **Participants**

107 IU undergraduates (45 female) participated in the present experiment for partial course credit. Participants were randomly assigned to one of three experimental conditions (i.e., physical, mental, control).

### **Procedure**

In an initial survey session, participants completed a variety of individual difference measures, including LI, LTW, TSC, and MPO. Participants who completed this initial survey were then recruited to participate in a subsequent experimental session 2 to 4 weeks later (see Study 2). Within this subsequent session, participants were escorted to an individual computer cubicle that described their two upcoming studies, one involving collaboration between the Psychology and Communications departments, and one involving collaboration between the Psychology and Kinesiology departments. This cover story was provided to amplify the perceived distinctiveness between the experimental manipulation and dependent measurement, as well as to increase the perceived legitimacy of the study being conducted.

Upon reading this cover story, participants then progressed into the first “experiment”, in which they read two potential articles purportedly under review for publication at the Indiana Daily Student, a popular student-run newspaper on Indiana University Bloomington’s campus. Participants were informed to read each article carefully, and then to evaluate how interesting, thought-provoking, well-written, and easy to understand it was (see Appendix 2). They were told that their responses would be used to determine the suitability of this article for publication at a later date, and that they

should take the task very seriously. Next, participants were exposed to the articles, the first of which served as a filler article, and the second of which served as the experimental manipulation. Specifically, the first article described recent construction projects at IU and the hassles that such projects cause students, and the second article described the challenges faced by student-athletes at IU.

For this second article, participants were randomly assigned to receive one of three versions, each of which used different terminology to discuss the difficulties experienced by student-athletes (see Appendix 5). In all versions, participants read about how student-athletes face early-morning schedules, long practice hours, extensive travel, and potential injuries. However, the nature of these challenges facing such athletes was described uniquely as a function of condition. That is, the physical (mental) version described each difficulty experienced by the student-athletes with accompanying physiological (psychological) consequences, whereas the neutral version described each difficulty without explicit reference to either physiological or psychological consequences. A pilot study showed that this manipulation effectively varied the extent to which participants perceive a variety of hypothetical tasks as mentally engaging, including the handgrip and cold pressor tasks used in Studies 2 and 3 (see Appendix 1).

Upon completing both articles and providing their subjective ratings of each, participants were escorted to the second “experiment”, involving the CPT. Specifically, they followed the experimenter to a separate cubicle in the laboratory, in which a large water basin was located on the center of the desk. The experimenter then briefed the participant concerning the nature of the upcoming task, which was to immerse their hand in cold water for as long as they possibly can. The water was measured for temperature

while the participant completed the article evaluation task, and these measurements indicated that the water was consistently within the intended temperature range (i.e., 33-37° F;  $M = 35.4^{\circ}$  F,  $SD = 1.65^{\circ}$  F, Minimum = 31.9° F, Maximum = 39.1° F). The experimenter further reinforced the cover story for this task, stating that this experiment was being conducted in collaboration between the Psychology and Kinesiology departments. The participant was asked to persist on this task for as long as they possibly could, such that the laboratory could obtain a valid measure of their pain persistence for future research at IU.

After this introduction, participants were asked to remove all jewelry on their hands, wrists, and arms, as well as to remove any sweaters or to roll up their sleeves if wearing long-sleeved shirts/blouses. Participants were then asked to quickly “test” the water using a finger from their non-dominant hand, in order to get a feeling for how cold the water was. The experimenter reinstructed the participant that he/she was allowed to remove their hand from the water at any time, but that the experiment’s results were contingent on their hand staying submerged in the water for as long as possible. The experimenter verbally ensured the participant that any pain experienced during the task would dissipate quickly upon removal from the water, and that this task was widely-utilized as a safe and valid measure of pain persistence. Finally, the experimenter informed the participant that their overall pain level would be tracked throughout the procedure, in the form of a closed-ended response format (see Measures).

After ensuring there were no outstanding questions or concerns, the experimenter instructed the participant to place their dominant hand in the water, and to continue moving their hand downwards until their fingers touched the bottom of the water basin.

Upon following these instructions, the participant's hand and wrist were completely submerged in the water, and the experimenter began timing the participant's persistence using a stopwatch. During the immersion task, the experimenter remained silent except to ask the extent to which the participant was currently feeling pain (every 20 seconds, using the prompt: "What is your pain level now?"). The experimenter informed the participant beforehand that he/she would indeed remain silent, such that participants did not attempt to have a conversation while completing the task.

When the participant was no longer able to keep their hand and wrist submerged in the water, they were allowed to remove the hand from the water and place it in a towel next to the water basin. Upon completely drying their hand, participants were informed that they were finished with this portion of the experimental protocol, and were escorted back into their original computer cubicle to answer a series of questions about the task (see Measures). Upon completion of these measures, participants were debriefed regarding the relationship between the two experimental tasks, and were allowed to ask questions before being dismissed from the study. Importantly, the experimenter ensured the participant was no longer experiencing pain in their hand before exiting the laboratory. No participant reported experiencing more than minimal pain when leaving the experiment.

## **Measures**

As in Study 2, all measurements are described briefly within the main text. The exact wordings and scales used for each item can be found in Appendix 1.

*Demographic Information.* See Study 2.

*Individual Differences.* As in Study 2, participants completed indices of LI ( $\alpha = .73$ ), LTW ( $\alpha = .86$ ), TSC ( $\alpha = .79$ ), and MPO.

*Article Evaluations.* Upon reading each purported student op-ed article, participants were asked several questions concerning their overall interest in the article (i.e., “How interesting did you find this article?”), as well as their perceptions of the clarity (i.e., “How clear was the writing in this article?”), organization (i.e., “How well organized were the author’s thoughts?”), overall quality (i.e., “How much did you like reading this article?”) and worthiness of publication (i.e., “How much would you recommend that this article be published in the Indiana Daily Student?”). Of interest to the present study was the overall index of positivity towards the student-athlete article ( $\alpha = .93$ ).

*CPT Persistence.* As mentioned above, participants were timed according to how long they were able to keep their hand submerged in the cold water (in sec). Persistence times were rounded to the nearest second. Given the fact that tissue damage to the hand can occur when participants’ hands are submerged in cold water for greater than 10 min, I set a threshold of 5 min for the persistence task. Although participants were not informed of this threshold before beginning the task, any participant who kept their hand submerged in the water for 5 min ( $n = 33$ ) was asked to remove their hand from the water basin at that point in the protocol.<sup>5</sup>

*Perceived Pain.* During the CPT task, participants were asked about the amount of pain that they were experiencing at 20-sec intervals. This report was made using the same scale as in Study 2 (see Appendix 4), which assessed pain on a scale ranging from 0(*No pain at all*) to 10(*Excruciating pain*). A final assessment of pain was taken just after

the participant removed his/her hand from the water basin. As in Study 2, we utilized the slope of perceived pain as our main dependent measure from these assessments by subtracting the participant's initial pain score from their final pain score, divided by their overall persistence on the task.

*Mood.* Participants' current affective state and perceived mental depletion were obtained in the same manner as in Study 2. Again, the mood and perceived depletion indices combined to form a reliable index of overall state positivity ( $\alpha = .73$ ).

*Motivation.* As in Study 2, participants were asked about their retrospective and prospective motivation towards the persistence task just completed.

*CPT Perceptions.* As in Study 2, participants were asked several questions regarding their perceptions of the persistence task, including its subjective difficulty, physical nature ( $r = .51, p = .001$ ), mental nature ( $r = .24, p = .01$ ), and mental-versus-physical nature.

*CPT Thoughts.* As in Study 2, participants were asked about their experience with the persistence task in an open-ended format. Specifically, they listed the first 3 to 4 thoughts that came to mind when considering the CPT procedure. The data from this thought-listing task was provided to three independent coders (i.e., research assistants within the laboratory), who assessed the extent to which each participant's response listed terms referring to mental processes (e.g., brain processes, self-control, willpower), physical processes (e.g., arm/hand sensations, blood flow, muscle use), fatigue (e.g., stamina, exhaustion, mental tiredness), and difficulty (e.g., pain, challenge). Inter-rater reliability was promoted via the coders discussing ten randomly selected participant responses, after which point each coder completed the remainder of participant responses

independently. Results indicated good reliability (mental,  $\alpha = .89$ ; physical,  $\alpha = .86$ ; difficulty,  $\alpha = .87$ ; fatigue,  $\alpha = .83$ ), allowing ratings to be averaged across coders to form separate indices of mental terms, physical terms, fatigue terms, and difficulty terms among each participant.

## Results

Unless otherwise noted, all analyses tested the effect of condition (-1 = Physical, +1 = Mental), lay interactionism (mean-centered), and their interaction term on the dependent measure of interest. These effects were tested via moderated linear regression analyses, with potential covariates assessed in an initial block (i.e., mood, participant gender, initial water temperature), main effects assessed in a secondary block (i.e., experimental condition, LI), and the Condition x LI interaction assessed in a final block. All of these results, along with descriptive statistics from the present study, can be found in Tables 2-4. Below, I outline the results in sequential order, starting with the first block (covariates) and ending with the final block (interaction term).

### Article Evaluations

I first assessed the extent to which participant and contextual factors influenced perceptions of the student-athlete article. The primary block was not significant,  $F(2, 69) = 0.84, p = .43$ , and indicated no effect of participant mood ( $\beta = .00, t(69) = 0.02, p = .98$ ) or participant gender ( $\beta = -.09, t(69) = -0.69, p = .49$ ). The secondary block was also not significant,  $F(4, 67) = 0.49, p = .74$ , and indicated no effect of LI ( $\beta = .06, t(67) = 0.44, p = .66$ ) or condition ( $\beta = .06, t(67) = 0.47, p = .64$ ). The final block was not significant,  $F(5, 66) = 0.39, p = .86$ , and indicated no interaction between condition and LI ( $\beta = -.02, t(66) = -.16, p = .88$ ).

### **CPT Persistence**

The primary dependent measure of interest was how long participants kept their hand fully immersed in the water basin before removal. The primary block was not significant,  $F(3, 68) = 0.60, p = .62$ , and indicated no effect of participant mood ( $\beta = .10, t(68) = 0.77, p = .45$ ), participant gender ( $\beta = .06, t(68) = 0.50, p = .62$ ), or initial water temperature ( $\beta = .10, t(68) = 0.79, p = .43$ ). The secondary block was not significant,  $F(5, 66) = 0.92, p = .47$ , and indicated no effect of LI ( $\beta = .17, t(66) = 1.35, p = .18$ ) or condition ( $\beta = -.13, t(66) = -1.07, p = .29$ ; see Figure 2). This null effect of condition stands in contrast to the significant effect of condition obtained in Study 2, an observation that I return to in the Discussion section. The final block was also not significant,  $F(6, 65) = 0.77, p = .60$ , and indicated no interaction between condition and LI ( $\beta = .03, t(65) = 0.27, p = .79$ ).

To offer comparison to the findings from Study 2, I also chose to conduct post-hoc pairwise comparisons of persistence as a function of experimental condition. These analyses revealed that participants in the mental condition showed significantly lower persistence on the CPT than did participants in the neutral control condition ( $t(69) = 2.10, p = .04$ ). All other between-condition comparisons were not significant ( $t < 1.20, p > .23$ ).

### **Perceived Pain**

As in Study 2, the primary metric of perceived pain in the present study was pain slope, which was calculated by dividing the overall range of the participant's pain report by the amount of time the participant spent on the task. The primary block predicting pain slope was not significant,  $F(3, 68) = 0.63, p = .60$ , and indicated no effect of participant mood ( $\beta = -.05, t(68) = 0.37, p = .71$ ), participant gender ( $\beta = .06, t(68) = 0.46, p = .65$ ),



or initial water temperature ( $\beta = -.16$ ,  $t(68) = -1.31$ ,  $p = .19$ ). The secondary block was not significant,  $F(5, 66) = 0.39$ ,  $p = .85$ , and indicated no effect of LI ( $\beta = -.02$ ,  $t(66) = -0.18$ ,  $p = .86$ ) or condition ( $\beta = .04$ ,  $t(66) = 0.32$ ,  $p = .75$ ). Post-hoc comparisons showed no significant differences between conditions ( $t < .80$ ,  $p > .42$ ). The final block was also not significant,  $F(6, 65) = 0.81$ ,  $p = .56$ , and indicated a marginal interaction between condition and LI ( $\beta = .22$ ,  $t(65) = 1.69$ ,  $p = .10$ ). Given this interaction, I conducted a simple slopes analysis to examine the effect of experimental condition at high (+1 SD), medium (0 SD), and low (-1 SD) levels of LI. However, results showed no effect of condition at high ( $\beta = .22$ ,  $t(65) = 1.37$ ,  $p = .18$ ), medium ( $\beta = .02$ ,  $t(65) = 0.18$ ,  $p = .86$ ), or low ( $\beta = -.18$ ,  $t(65) = -1.01$ ,  $p = .32$ ) levels of LI.

### **CPT Perceptions**

There were four metrics of CPT perceptions employed in the present study: mental task perceptions (i.e., extent to which the task involves the operation of mental faculties), physical task perceptions (i.e., extent to which the task involves the operation of physical faculties), mental-versus-physical task perceptions (i.e., the extent to which the task involves a relative majority of mental or physical faculties), and task difficulty perceptions (i.e., the subjective experience of difficulty encountered throughout the task). I outline the results for each of these metrics below.

*Mental Task Perceptions.* The primary block predicting mental task perceptions was not significant,  $F(3, 68) = 1.72$ ,  $p = .17$ , and indicated no effect of participant mood ( $\beta = .17$ ,  $t(68) = 1.37$ ,  $p = .17$ ), participant gender ( $\beta = -.18$ ,  $t(68) = -1.44$ ,  $p = .16$ ), or initial water temperature ( $\beta = -.14$ ,  $t(68) = -1.14$ ,  $p = .26$ ). The secondary block was significant,  $F(5, 66) = 2.58$ ,  $p = .03$ , and indicated no effect of condition ( $\beta = -.11$ ,  $t(66) =$

-1.00,  $p = .32$ ), and a significant effect of LI ( $\beta = .31$ ,  $t(66) = 2.58$ ,  $p = .01$ ). This latter effect shows that people who endorsed a greater overlap between mental and physical phenomena were more likely to perceive the CPT's mental nature. Thus, although all participants tended to perceive the CPT as mentally involving overall (i.e., the grand mean of 6.27 was significantly above the scalar midpoint of 5.00,  $t(106) = 8.83$ ,  $p < .001$ , high interactionists emphasized this mental involvement to a greater extent than did low interactionists. The final block was also significant,  $F(6, 65) = 2.74$ ,  $p = .02$ , and indicated a marginal interaction between condition and LI ( $\beta = -.21$ ,  $t(65) = -1.76$ ,  $p = .08$ ).

Although this interaction effect was marginal, I chose to explore its underlying nature using a simple slopes analysis. Results showed a marginal positive effect of condition at high LI ( $\beta = -.29$ ,  $t(65) = 1.93$ ,  $p = .06$ ), but showed no effect of condition at medium ( $\beta = -.10$ ,  $t(65) = -0.85$ ,  $p = .40$ ) or low ( $\beta = .10$ ,  $t(65) = 0.59$ ,  $p = .56$ ) levels of LI. These findings indicate that high interactionists tended to contrast their mental task perceptions away from the information primed by the prior reading task. That is, these participants were most likely to perceive the mental nature of the CPT task when they had been initially primed with physical terminology within an unrelated article (and vice-versa). This effect was not found in medium and low interactionist participants, who were relatively unaffected by the terminology primed in the previous task. While these findings conflict with the intention of the experimental manipulation, they offer some support for the proposition that high interactionists are those most likely to contrast to the framing implied by the contextual features of the experiment. Nonetheless, these

interpretations should be regarded with caution, given the marginal nature of the overall interaction effect.

*Physical Task Perceptions.* The primary block predicting physical task perceptions was not significant,  $F(3, 68) = 0.98, p = .41$ , and indicated no effect of participant mood ( $\beta = -.19, t(68) = -1.54, p = .13$ ), participant gender ( $\beta = -.02, t(68) = -0.16, p = .88$ ), or initial water temperature ( $\beta = -.07, t(68) = -0.55, p = .58$ ). The secondary block was also not significant,  $F(5, 66) = 1.11, p = .36$ , and indicated no effect of condition ( $\beta = -.04, t(66) = -0.32, p = .75$ ) or LI ( $\beta = .20, t(66) = 1.60, p = .12$ ). Thus, all participants tended to perceive the CPT as relatively low in physical involvement, regardless of their level of LI (i.e., the grand mean of 3.77 was significantly below the scalar midpoint of 5.00,  $t(106) = -6.84, p < .001$ ). The final block was also not significant,  $F(6, 65) = 1.15, p = .35$ , and showed no interaction between condition and LI ( $\beta = -.15, t(65) = -1.14, p = .26$ ).

*Overall Task Perceptions.* The primary block predicting overall task perceptions was marginally significant,  $F(3, 68) = 2.35, p = .08$ , and indicated no effect of participant gender ( $\beta = .17, t(68) = 1.40, p = .17$ ) or initial water temperature ( $\beta = .02, t(68) = 0.15, p = .88$ ), but did indicate a significant effect of participant mood ( $\beta = -.30, t(68) = -2.50, p = .02$ ). This latter effect implies that more positive moods led participants to perceive the task as more mental in nature. The secondary block was not significant,  $F(5, 66) = 1.73, p = .14$ , and indicated no effect of condition ( $\beta = -.13, t(66) = -1.06, p = .29$ ), or LI ( $\beta = -.08, t(66) = -0.63, p = .53$ ). Thus, all participants tended to perceive the task in relatively mental terms, regardless of their level of LI (i.e., the grand mean of 2.93 was significantly below the scalar midpoint of 5.00,  $t(106) = -11.00, p < .001$ ). The final block was

significant,  $F(6, 65) = 2.96, p = .01$ , and indicated an interaction between condition and LI ( $\beta = -.34, t(65) = -2.86, p = .01$ ).

Given this significant interaction, I conducted a simple slopes analysis examining the effect of experimental condition at different levels of LI. Results showed a significant negative effect of condition at high LI ( $\beta = -.41, t(65) = 2.73, p = .01$ ), but no effect of condition at medium ( $\beta = -.10, t(65) = -0.86, p = .39$ ) and low ( $\beta = .21, t(65) = 1.31, p = .19$ ) levels of LI. These findings are conceptually similar to those obtained for the mental task perception data, and again suggest that high interactionists are increasingly likely to contrast their task perceptions away from the information included within the experimental manipulation.

*Task Difficulty.* The primary block predicting subjective task difficulty was marginally significant,  $F(3, 68) = 2.42, p = .07$ , and indicated no effect of participant gender ( $\beta = -.16, t(68) = -1.30, p = .20$ ) or participant mood ( $\beta = -.13, t(68) = -1.10, p = .28$ ), but did indicate a marginal effect of initial water temperature ( $\beta = -.20, t(68) = -1.70, p = .09$ ). This latter effect suggests that lower temperatures led participants to perceive the CPT as more difficult. The secondary block was not significant,  $F(5, 66) = 1.79, p = .12$ , and indicated no effect of condition ( $\beta = -.05, t(66) = -0.41, p = .68$ ), or LI ( $\beta = -.16, t(66) = -1.33, p = .19$ ). The final block was also not significant,  $F(6, 65) = 1.66, p = .14$ , and indicated no interaction between condition and LI ( $\beta = -.13, t(65) = -1.05, p = .30$ ).

## **Motivation**

There were two metrics of motivation employed in the present study: retrospective motivation (i.e., extent to which participant reported working hard on the

CPT), and prospective motivation (i.e., extent to which the participant reported a willingness to complete another CPT later in the experiment). I discuss the results for each of these metrics below.

*Retrospective Motivation.* The primary block predicting retrospective motivation was not significant,  $F(3, 68) = 0.27, p = .85$ , and indicated no effect of participant gender ( $\beta = -.05, t(68) = -0.36, p = .72$ ), participant mood ( $\beta = .11, t(68) = 0.89, p = .38$ ), or initial water temperature ( $\beta = .01, t(68) = 0.08, p = .94$ ). The secondary block was not significant,  $F(5, 66) = 0.39, p = .85$ , and indicated no effect of condition ( $\beta = .04, t(66) = 0.28, p = .78$ ), or LI ( $\beta = .13, t(66) = 1.02, p = .31$ ). The final block was also not significant,  $F(6, 65) = 0.51, p = .80$ , and indicated no interaction between condition and LI ( $\beta = -.14, t(65) = -1.05, p = .30$ ).

*Prospective Motivation.* The primary block predicting prospective motivation was marginally significant,  $F(3, 68) = 2.60, p = .06$ , and indicated no effect of participant gender ( $\beta = -.02, t(68) = -0.18, p = .86$ ) or initial water temperature ( $\beta = .06, t(68) = 0.50, p = .62$ ), but did indicate a significant effect of participant mood ( $\beta = .32, t(68) = 2.72, p = .01$ ). This latter effect implies that more positive moods led participants to have greater prospective motivation. The secondary block was not significant,  $F(5, 66) = 1.82, p = .12$ , and indicated no effect of condition ( $\beta = -.11, t(66) = -0.93, p = .35$ ), or LI ( $\beta = .09, t(66) = 0.75, p = .46$ ). The final block was also not significant,  $F(6, 65) = 1.53, p = .18$ , and indicated no interaction between condition and LI ( $\beta = .06, t(65) = 0.44, p = .66$ ).

### **CPT Thoughts**

*Mental Thoughts.* The primary block predicting mental thoughts was not significant,  $F(3, 68) = 0.45, p = .72$ , and indicated no effect of participant gender ( $\beta = -$

.13,  $t(68) = -1.04$ ,  $p = .30$ ), participant mood ( $\beta = .06$ ,  $t(68) = 0.51$ ,  $p = .61$ ), or initial water temperature ( $\beta = .08$ ,  $t(68) = 0.62$ ,  $p = .54$ ). The secondary block was not significant,  $F(5, 66) = 0.29$ ,  $p = .92$ , and indicated no effect of condition ( $\beta = -.02$ ,  $t(66) = -0.16$ ,  $p = .87$ ) or LI ( $\beta = .04$ ,  $t(66) = 0.33$ ,  $p = .74$ ). The final block was also not significant,  $F(6, 65) = 0.25$ ,  $p = .96$ , and indicated no interaction between condition and LI ( $\beta = .04$ ,  $t(65) = 0.30$ ,  $p = .77$ ).

*Physical Thoughts.* The primary block predicting physical thoughts was not significant,  $F(3, 68) = 1.09$ ,  $p = .36$ , and indicated no effect of participant gender ( $\beta = -.07$ ,  $t(68) = -0.52$ ,  $p = .60$ ), participant mood ( $\beta = .19$ ,  $t(68) = 1.54$ ,  $p = .13$ ), or initial water temperature ( $\beta = -.09$ ,  $t(68) = -0.78$ ,  $p = .44$ ). The secondary block was not significant,  $F(5, 66) = 1.07$ ,  $p = .39$ , and indicated no effect of condition ( $\beta = .12$ ,  $t(66) = 1.02$ ,  $p = .31$ ) or LI ( $\beta = -.14$ ,  $t(66) = -1.08$ ,  $p = .29$ ). The final block was also not significant,  $F(6, 65) = 0.89$ ,  $p = .51$ , and indicated no interaction between condition and LI ( $\beta = -.04$ ,  $t(65) = -0.27$ ,  $p = .79$ ).

*Difficulty Thoughts.* The primary block predicting difficulty thoughts was not significant,  $F(3, 68) = 2.11$ ,  $p = .11$ , and indicated no effect of participant gender ( $\beta = -.10$ ,  $t(68) = -0.82$ ,  $p = .42$ ) or initial water temperature ( $\beta = -.05$ ,  $t(68) = -0.44$ ,  $p = .66$ ), but did indicate a significant effect of participant mood ( $\beta = -.25$ ,  $t(68) = -2.04$ ,  $p = .05$ ). This latter effect implies that participants in more negative moods were more likely to have thoughts concerning the overall difficulty of the CPT. The secondary block was marginally significant,  $F(5, 66) = 1.93$ ,  $p = .10$ , and indicated no effect of condition ( $\beta = .00$ ,  $t(66) = -0.01$ ,  $p = .99$ ), but did indicate a marginal effect of LI ( $\beta = .22$ ,  $t(66) = 1.79$ ,  $p = .08$ ). This latter effect suggests that participants higher in LI were more likely to have

thoughts concerning the overall difficulty of the CPT. The final block was not significant,  $F(6, 65) = 1.15, p = .14$ , and indicated no interaction between condition and LI ( $\beta = .09, t(65) = 0.71, p = .48$ ).

*Fatigue Thoughts.* The primary block predicting fatigue thoughts was not significant,  $F(3, 68) = 0.99, p = .41$ , and indicated no effect of participant gender ( $\beta = -.09, t(68) = -0.68, p = .50$ ), participant mood ( $\beta = .10, t(68) = 0.79, p = .43$ ), or initial water temperature ( $\beta = -.16, t(68) = -1.30, p = .20$ ). The secondary block was not significant,  $F(5, 66) = 0.72, p = .61$ , and indicated no effect of condition ( $\beta = .01, t(66) = 0.09, p = .93$ ) or LI ( $\beta = .10, t(66) = 0.82, p = .42$ ). The final block was also not significant,  $F(6, 65) = 0.97, p = .46$ , and indicated no interaction between condition and LI ( $\beta = -.19, t(65) = -1.47, p = .15$ ).

## Discussion

The results of Study 3 both diverge from and converge with the results of Study 2 in several important respects. In terms of divergence, Study 3 found minimal evidence supporting the notion that the mental/physical focus manipulation facilitated unique patterns of self-control exertion. That is, regardless of whether participants read about the challenges of student-athletes with mental, physical, or neutral terminology, they appeared to show relatively equivalent levels of behavioral persistence on the CPT. This result conflicts with Study 2, in which a mental task framing manipulation led to improved self-control exertion. While this divergence in behavioral effects can be attributed to several factors, two distinct possibilities involve the nature of the manipulations under study. For one, the manipulation in Study 2 was administered concurrently with the persistence task, whereas the manipulation in Study 3 was

administered prior to the persistence task. Second, the manipulation in Study 2 was explicitly relevant to the behavior of interest (i.e., reactions to the handgrip task), whereas the manipulation in Study 3 was more indirect in nature (i.e., reactions to challenging life circumstances in student-athletes). Both of these differences increase the probability that the manipulation in Study 2 would be more effectual than that of Study 3, as well as the probability that the manipulation in Study 2 could elicit greater demand characteristics than that of Study 3.

In contrast to their divergence in behavioral effects, Study 2 and 3 appear to converge regarding the influence LI on the perceptual metrics under study. That is, LI again predicted the extent to which participants perceived the persistence task in more mental or physical terms. High interactionists were more likely to perceive the CPT in mental terms, whereas low interactionists were more likely to perceive the task in physical terms. Although this perceptual difference did not effectively predict behavioral responding (see Table 6), the fact that LI corresponded with perceptual metrics across two divergent self-regulatory contexts (i.e., handgrip, CPT) suggests that this individual difference measure is important to account for within self-control performance, particularly when this performance involves both physiological and psychological mechanisms that an individual can readily understand. Thus, when researchers utilize precise assessments of self-control exertion in controlled environments, of which the CPT and handgrip are conventional examples, they will likely benefit from an understanding of how these tasks are perceived (i.e., mental and physical involvement), as well as how these perceptions change in relation to relevant individual difference measurements (e.g., LI).



In discussing the role of task perceptions within self-control tasks, it is important to note that the tasks in Studies 2 and 3 were perceived in relatively different ways by participants in general. That is, irrespective of LI scores, participants tended to perceive the handgrip persistence task (see Study 2) at the relative intersection of mental and physical involvement, whereas participants tended to perceive the CPT persistence paradigm as significantly more mental than physical in nature. Such results are relatively surprising from an intuitive standpoint, as exposing the skin to extreme temperatures for extended time periods involves the engagement of physical systems (i.e., temperature regulation, blood flow), just as using one's muscles for extended time periods involves the engagement of physical systems. However, the perceptual data from these studies suggests that particular aspects of the CPT cause it to be perceived in less physical terms than is a handgrip persistence task. While speculative, one possibility is that disengagement from the CPT is perceived to require a conscious choice (i.e., "I will now remove my hand") whereas disengagement on the handgrip task is perceived to be relatively uncontrollable (i.e., "My arm cannot persist any longer"), and this experience of choice causes task performance to emphasize mental - rather than physical - task perceptions.

Irrespective of speculation, the divergence in task perceptions between the handgrip and CPT paradigms offers another plausible explanation concerning the divergence in results between these two studies. That is, when a task has relatively pronounced physical requirements (i.e., handgrip), manipulations that focus an individual on the mental requirements of this task may serve as a temporary distraction from the difficulty experienced by such physical systems. This distraction may come in the form

of lesser sensitivity to phenomenological indicators of physical system failure (e.g., lower pain slope; see Study 2). In contrast, when a task has relatively pronounced mental requirements (i.e., CPT), manipulations that focus individuals on the mental requirements of this task may not aid the participant in any meaningful way, and may even undermine performance in particular circumstances. As such, the failure to obtain significant effects of experimental condition may not reflect a weak contextual manipulation; it may reflect a lack of synchrony between the effect of the manipulation and the nature of the task under study.

### **Study 4**

Because Studies 2 and 3 examined the effects of contextual framing and lay interactionism on tasks with a pronounced physical component (i.e., muscle engagement - Study 2; arm immersion - Study 3), Study 4's primary objective was to utilize a task with a less pronounced physical component. Using a task with minimal physical exertion allows an examination of how the contextual and individual differences under study impact perceptual and behavioral performance when task perceptions are relatively constrained. Given that most physical persistence tasks invariably invoke a level of mental exertion (a conclusion supported by task perception data from Studies 2 and 3), it would appear that a mental persistence task - here a Stroop interference task - offers the best option by which the factors under study can be examined in a less dualistic self-control context.

### **Method**

#### **Participants**

179 IU undergraduates (113 female) participated in the present study for partial course credit. Paralleling the format of Studies 2 and 3, participants were randomly assigned to one of three conditions (mental, physical, control).

### **Procedure**

Participants completed an initial survey session, in which they reported demographic and individual difference information of interest to the present work. Following their completion of this survey session, participants were recruited to participate in a subsequent experiment two to four weeks later (see Studies 2 and 3). Interested participants reported for a subsequent session titled “Thought and Action”. Upon arriving for the study and providing consent, participants were escorted to an individual cubicle within the laboratory, in which they read a similar cover story as was described in Study 3. That is, participants were informed that they would be completing two experimental protocols within their current session, the first of which involved collaboration between the Psychology and Journalism departments, and the second of which involved collaboration between the Psychology and Kinesiology departments.

After reading the cover story, participants were presented with the first “experiment”, in which they read and responded to two student op-ed articles, the second of which served as the experimental manipulation (see Study 3). After completing these articles, participants transitioned into the second “experiment”, concerning their ability to differentiate color and text information presented on a computer screen. The computer informed participants of the importance of this experiment, as well as the necessity of following instructions for this experiment. The computer then provided participants with directions for the upcoming task, which consisted of three increasingly detailed screens

of information regarding their objective, which was to identify the font color of each word presented as quickly and accurately as possible.

After reading these instructions and completing a short set of practice trials ( $n = 24$ ), participants completed the actual Stroop assessment, in which they responded with the color of each word presented on the screen using one of three different buttons located on the computer's numeric keypad (see Measures). Subsequent to this assessment (i.e., 120 trials), participants were asked several questions concerning their perceived depletion, motivation, task perceptions, and task interest. Finally, participants were debriefed and dismissed from the study.

### **Measurements**

As in Studies 2 and 3, measurements are described briefly in the main text. The exact items and scales utilized can be found in Appendix 1.

*Demographics.* See Studies 2 and 3.

*Individual Differences.* As in Studies 2 and 3, participants completed indices of LI ( $\alpha = .77$ ), LTW ( $\alpha = .82$ ), TSC ( $\alpha = .83$ ), and MPO.

*Mood.* See Studies 2 and 3 ( $\alpha = .75$ ).

*Article Evaluations.* As in Study 3, participants rated each article on several metrics. Of interest to the present study was the overall index of positivity towards the student-athlete article ( $\alpha = .94$ ).

*Stroop Performance.* To measure self-control performance, a computerized Stroop paradigm was employed. This paradigm requires participants to quickly and accurately identify the font color of a series of words in which the font color and word name are either congruent (e.g., the word “red” printed in red font) or incongruent (e.g.,

the word “red” printed in blue font). Each word was presented on screen for 500ms, and the inter-trial interval was 250ms. Incorrect responses caused the computer to display a red “X” at the center of the screen for 500ms. Responses on this task were assessed and recorded using Direct RT software.

Upon introduction to the task and a set of practice trials ( $n = 24$ ), participants completed 120 Stroop trials (60 congruent, 60 incongruent) using 3 different word and font colors (i.e., red, blue, green). The accuracy (error rate: total errors/total trials) and latency (in milliseconds) of each response was electronically recorded and grouped by trial type. Trials with response latencies that fell below 200ms and above 2000ms, and participants with errors on more than 25% of trials, were removed from all analyses. Responses associated with incorrect answers, as well as responses falling  $\pm 3$  standard deviations from the participant’s mean response time were omitted from latency analyses (Kane & Engle, 2003).

Self-control effectiveness on the Stroop task was assessed by measuring performance discrepancies between congruent and incongruent trials, with lower self-regulatory ability evidenced by less effective performance on incongruent, relative to congruent, trials (Gutsell & Inzlicht, 2007; Job et al., 2010). To this end, I calculated *Stroop interference* by subtracting aggregated performance on congruent trials from aggregated performance on incongruent trials, with higher scores indicating greater evidence of Stroop interference. Given mixed evidence for interference being more meaningful in terms of response latency (e.g., Inzlicht & Gutsell, 2007) or error rate (e.g., Job et al., 2010; Smith, Jostmann, Galinsky, & van Dijk, 2008), I included both metrics

(i.e., *Stroop latency interference*, *Stroop accuracy interference*) when analyzing the present results.

*Task Perceptions.* Parallel to the format of Studies 2 and 3, participants were asked several questions about their perceptions of dependent measurement upon its completion. Specifically, they indicated the difficulty (2 items;  $r = .51$ ), physical nature (2 items;  $r = .36$ ), mental nature (3 items;  $\alpha = .76$ ), and overall nature (i.e., mental-versus-physical; 1 item) of the Stroop task.

*Motivation.* As in Studies 2 and 3, participants were asked about their retrospective (2 items;  $r = .71$ ) and prospective (1 item) motivation towards the dependent measurement.

## Results

Unless otherwise noted, all analyses tested the effect of condition (-1 = Physical, +1 = Mental), lay interactionism (mean-centered), and their interaction term on the dependent measure of interest. These effects were tested via moderated linear regression analyses, with potential covariates assessed in an initial block (i.e., mood, participant gender), main effects assessed in a secondary block (i.e., experimental condition, LI), and the Condition x LI interaction assessed in a final block. All results from these analyses, along with descriptive statistics of the present work, can be found in Tables 2-4. Below, I outline the results in sequential order, starting with the initial block (covariates) and ending with the final block (interaction term).

### Article Evaluations

As in Study 3, I first assessed the extent to which participant and contextual factors influenced perceptions of the student-athlete article. The primary block was not

significant,  $F(2, 116) = 1.23, p = .30$ , and indicated no effect of participant mood ( $\beta = .14, t(116) = 1.47, p = .14$ ) or participant gender ( $\beta = -.06, t(116) = -0.60, p = .55$ ). The secondary block was marginally significant,  $F(4, 114) = 2.35, p = .06$ , and indicated no effect of condition ( $\beta = -.09, t(114) = -1.00, p = .32$ ), but indicated a highly significant effect of LI ( $\beta = .23, t(114) = 2.48, p = .02$ ). This latter effect shows that higher LI scores corresponded to a more positive overall evaluation of the article. The final block was significant,  $F(5, 113) = 2.54, p = .03$ , and indicated a marginal interaction between condition and LI ( $\beta = .16, t(113) = 1.77, p = .08$ ).

Although this interaction was marginal in nature, I nonetheless chose to conduct a simple slopes analysis in order to understand the effect of condition at high (+1 SD), medium (0 SD), and low (-1 SD) levels of LI. At high ( $\beta = .07, t(113) = 0.55, p = .59$ ) and medium ( $\beta = -.09, t(113) = -0.99, p = .32$ ) levels of LI, there was a no effect of condition. However, at low levels of LI, there was a significant negative effect of condition ( $\beta = -.25, t(113) = 1.96, p = .05$ ), such that the story was perceived more positively as its focus became more physical. Given this interactive effect, as well as the other main effects concerning LI and gender, all subsequent analyses control for article evaluations. However, because these patterns of findings were not obtained in Study 3, they are not discussed further.

### **Stroop Performance**

As mentioned in the Methods section, there were two viable metrics of cognitive interference measured in the present study. For one, I assessed Stroop latency interference by subtracting average response time on congruent trials from average response time on incongruent trials. Second, I assessed Stroop error interference by

subtracting overall error rate on congruent trials from overall error rate on incongruent trials. In both cases, higher scores are indicative of greater interference, and thus poorer overall self-control performance.

Although there exists theoretical and empirical evidence to suggest that Stroop latency and Stroop errors are relatively orthogonal metrics of cognitive interference (e.g., Dulaney & Rogers, 1994; Kane & Engle, 2003), the present results indicated that these metrics were significantly positively correlated with one another ( $r = .15, p = .05$ ). As such, after presenting the results for these metrics separately, I present the same conceptual analysis using a combined z-score metric of Stroop performance, which is labeled *overall Stroop performance* (i.e., the summation of participant z-scores on the Stroop latency and Stroop error metrics, divided by two).

*Stroop Latency Interference.* The primary block assessing Stroop latency interference was not significant,  $F(3, 115) = 1.73, p = .17$ , and indicated no effect of participant mood ( $\beta = .14, t(115) = 1.49, p = .14$ ) or participant gender ( $\beta = -.05, t(115) = -0.56, p = .58$ ), but did indicate a marginal effect of article evaluations ( $\beta = -.17, t(115) = -1.86, p = .07$ ). This latter effect suggests that participants who disliked the article tended to show more Stroop latency interference. The secondary block was not significant,  $F(5, 113) = 1.28, p = .28$ , and indicated no effect of LI ( $\beta = .02, t(113) = 0.17, p = .87$ ) or condition ( $\beta = -.10, t(113) = -1.11, p = .27$ ). The final block was also not significant,  $F(6, 112) = 1.45, p = .20$ , and indicated no interaction between condition and LI ( $\beta = -.14, t(112) = -1.49, p = .14$ ).

*Stroop Error Interference.* The primary block assessing Stroop error interference was not significant,  $F(3, 115) = 0.12, p = .95$ , and indicated no effect of participant mood



( $\beta = .04$ ,  $t(115) = 0.39$ ,  $p = .70$ ), participant gender ( $\beta = .02$ ,  $t(115) = 0.20$ ,  $p = .84$ ), or article evaluations ( $\beta = -.04$ ,  $t(115) = -0.44$ ,  $p = .66$ ). The secondary block was not significant,  $F(5, 113) = 0.77$ ,  $p = .58$ , and indicated no effect of LI ( $\beta = -.06$ ,  $t(113) = -0.60$ ,  $p = .55$ ), but showed a marginal effect of condition ( $\beta = -.16$ ,  $t(113) = -1.70$ ,  $p = .09$ ). This latter effect suggests that as the article manipulation shifted from a physical to a mental focus, participants showed less evidence of Stroop error interference. The final block was again not significant,  $F(6, 112) = 0.63$ ,  $p = .70$ , and indicated no interaction between condition and LI ( $\beta = .01$ ,  $t(112) = 0.10$ ,  $p = .92$ ).

*Overall Stroop Performance.* The primary block assessing overall Stroop performance was not significant,  $F(3, 115) = 0.98$ ,  $p = .40$ , and indicated no effect of participant mood ( $\beta = .10$ ,  $t(115) = 1.15$ ,  $p = .25$ ), participant gender ( $\beta = -.02$ ,  $t(115) = -0.19$ ,  $p = .85$ ), or article evaluations ( $\beta = -.13$ ,  $t(115) = -1.41$ ,  $p = .16$ ). The secondary block was not significant,  $F(5, 113) = 1.33$ ,  $p = .26$ , and indicated no effect of LI ( $\beta = -.03$ ,  $t(113) = -0.32$ ,  $p = .75$ ), but showed a marginal effect of condition ( $\beta = -.17$ ,  $t(113) = -1.85$ ,  $p = .07$ ). As with the error interference data, this conditional effect suggests that as the article manipulation shifted from a physical to a mental focus, participants showed less evidence of Stroop error interference (see Figure 1). To explore this effect further, I conducted a series of pairwise comparisons assessing differences in overall Stroop performance as a function of experimental condition. These analyses showed that the Stroop interference of participants in the mental condition ( $M = -.128$ ,  $SD = .710$ ) tended to be lower than participants in the physical condition ( $M = .129$ ,  $SD = .893$ ),  $t(117) = 1.74$ ,  $p = .08$ . No other differences between conditions approached statistical reliability.

The final block was again not significant,  $F(6, 112) = 1.22, p = .30$ , and indicated no interaction between condition and LI ( $\beta = -.08, t(112) = -0.82, p = .41$ ).

### **Stroop Task Perceptions**

There were four metrics of Stroop task perceptions employed in the present study: mental task perceptions (i.e., extent to which the task involves the operation of mental faculties), physical task perceptions (i.e., extent to which the task involves the operation of physical faculties), mental-versus-physical task perceptions (i.e., the extent to which the task involves a relative majority of mental or physical faculties), and task difficulty perceptions (i.e., the subjective experience of difficulty encountered throughout the task). I outline the results for each of these metrics below.

*Mental Task Perceptions.* The primary block assessing mental task perceptions was significant,  $F(3, 115) = 5.27, p = .002$ , and indicated no effect of participant mood ( $\beta = .08, t(115) = 0.88, p = .38$ ), but did indicate a significant effects of article evaluations ( $\beta = .17, t(115) = 1.96, p = .05$ ) and participant gender ( $\beta = -.28, t(115) = -3.19, p = .002$ ). These latter findings show that participants were increasingly likely to emphasize the mental nature of the Stroop task when they evaluated the student-athlete article positively or when they were female. The secondary block was also significant,  $F(5, 113) = 7.78, p < .001$ , and indicated significant effects of both LI ( $\beta = .35, t(113) = 4.06, p < .001$ ) and condition ( $\beta = -.20, t(113) = -2.39, p = .02$ ). The former effect shows that high interactionists were much more likely to emphasize the mental nature of the Stroop task in comparison to low interactionists. The latter effect shows that the article manipulation had an ironic effect on perceptions of the Stroop task, such that when the information within the article emphasized mental outcomes, participants were decreasingly likely to

emphasize the mental nature of the task. Together then, although participants tended to perceived the Stroop as mental (i.e., the grand mean of 6.49 was significantly above the scalar midpoint of 5.00,  $t(178) = 6.44, p < .001$ ), this perception was heightened at higher levels of LI and dampened as the article information focused on mental phenomena. The final block was significant,  $F(6, 112) = 9.58, p < .001$ , but indicated no interaction between condition and LI ( $\beta = -.02, t(112) = -0.28, p = .78$ ).

*Physical Task Perceptions.* The primary block assessing physical task perceptions was not significant,  $F(3, 115) = 0.82, p = .49$ , and indicated no effect of participant mood ( $\beta = .02, t(115) = 0.23, p = .82$ ), participant gender ( $\beta = -.06, t(115) = -0.65, p = .52$ ), or article evaluations ( $\beta = .12, t(115) = 1.34, p = .19$ ). The secondary block was not significant,  $F(5, 113) = 0.54, p = .75$ , and indicated no effects of either LI ( $\beta = .04, t(113) = 0.38, p = .70$ ) or condition ( $\beta = -.04, t(113) = -0.40, p = .69$ ). Thus, participants tended to deemphasize the physical nature of the Stroop task (i.e., the grand mean of 4.37 was significantly below the scalar midpoint of 5.00,  $t(178) = -5.14, p < .001$ ), irrespective of LI or experimental condition. The final block was also not significant,  $F(6, 112) = 0.74, p = .62$ , and indicated no interaction between condition and LI ( $\beta = .13, t(112) = 1.31, p = .19$ ).

*Overall Task Perceptions.* The primary block assessing overall task perceptions was not significant,  $F(3, 115) = 0.31, p = .82$ , and indicated no effect of participant mood ( $\beta = .04, t(115) = 0.47, p = .64$ ), participant gender ( $\beta = -.07, t(115) = -0.71, p = .48$ ), or article evaluations ( $\beta = -.06, t(115) = -0.59, p = .56$ ). The secondary block was not significant,  $F(5, 113) = 1.05, p = .39$ , and indicated no effect of condition ( $\beta = .01, t(113) = 0.15, p = .88$ ), but did indicate a significant effect of LI ( $\beta = -.20, t(113) = -2.07, p =$

.04). This latter effect shows that people who endorsed a greater overlap between mental and physical phenomena were more likely to perceive the Stroop task in mental terms. Thus, although the Stroop task was generally perceived as mental in nature (i.e., the grand mean of 2.70 was significantly below the scalar midpoint of 5.00,  $t(178) = -18.31$ ,  $p < .001$ ), high interactionists emphasized this mental involvement to a greater extent than did low interactionists. The final block was also not significant,  $F(6, 112) = 0.89$ ,  $p = .50$ , and indicated no interaction between condition and LI ( $\beta = .04$ ,  $t(112) = 0.39$ ,  $p = .70$ ).

*Task Difficulty.* The primary block assessing task difficulty was marginally significant,  $F(3, 115) = 3.44$ ,  $p = .02$ , and indicated no effect of participant gender ( $\beta = .06$ ,  $t(115) = 0.69$ ,  $p = .49$ ), but did indicate significant effects of participant mood ( $\beta = -.22$ ,  $t(115) = -2.44$ ,  $p = .02$ ) and article evaluations ( $\beta = .21$ ,  $t(115) = 2.35$ ,  $p = .02$ ). Thus, participants were more likely to perceive the Stroop task as difficult when they were in a negative mood or when they evaluated the article positively. The secondary block was significant,  $F(5, 113) = 2.41$ ,  $p = .04$ , but indicated no effect of condition ( $\beta = -.05$ ,  $t(113) = -0.57$ ,  $p = .57$ ) or LI ( $\beta = .12$ ,  $t(113) = 1.24$ ,  $p = .22$ ). The final block was marginally significant,  $F(6, 112) = 2.05$ ,  $p = .07$ , but indicated no interaction between condition and LI ( $\beta = -.05$ ,  $t(112) = -0.54$ ,  $p = .59$ ).

## **Motivation**

There were two metrics of motivation employed in the present study: retrospective motivation (i.e., extent to which participant reported working hard on the Stroop task), and prospective motivation (i.e., extent to which the participant reported a

willingness to complete another Stroop task later in the experiment). I discuss the results for each of these metrics below.

*Retrospective Motivation.* The primary block assessing retrospective motivation was significant,  $F(3, 115) = 7.57, p < .001$ , and indicated no effect of article evaluations ( $\beta = .12, t(115) = 1.36, p = .18$ ), but did indicate significant effects of participant mood ( $\beta = .33, t(115) = 3.78, p < .001$ ) and participant gender ( $\beta = -.19, t(115) = -2.27, p = .03$ ). These latter effects show that participants reported higher motivation when they were in a positive mood or when they were female. The secondary block was significant,  $F(5, 113) = 5.82, p < .001$ , and indicated no effect of condition ( $\beta = -.09, t(113) = -1.04, p = .30$ ), but did indicate a significant effect of LI ( $\beta = .20, t(113) = 2.23, p = .03$ ). This latter effect shows that participants who endorsed a greater overlap between mental and physical phenomena were more likely to report being motivated to work hard on the Stroop task. The final block was also significant,  $F(6, 112) = 5.44, p < .001$ , and indicated a marginal interaction between condition and LI ( $\beta = -.15, t(112) = -1.74, p = .09$ ).

Given the marginal nature of this interaction, I utilized a simple slopes analysis to determine the effect of experimental condition at high (+1 SD), medium (0 SD), and low (-1 SD) levels of LI. At high levels of LI, there was a significant negative effect of condition ( $\beta = -.24, t(112) = -1.97, p = .05$ ), such that as the article manipulation shifted focus from a physical to mental focus, participants reported lesser motivation on the Stroop task. At medium ( $\beta = -.09, t(112) = -1.04, p = .30$ ) and low ( $\beta = .06, t(112) = 0.50, p = .62$ ) levels of LI, there was no effect of condition.

*Prospective Motivation.* The primary block assessing prospective motivation was significant,  $F(3, 115) = 1.84, p = .14$ , and indicated no effect of participant gender ( $\beta = -.06, t(115) = -0.62, p = .54$ ) or article evaluations ( $\beta = .09, t(115) = 0.93, p = .35$ ), but did indicate a marginal effect of participant mood ( $\beta = .18, t(115) = 1.93, p = .06$ ). This latter effect shows that participants reported greater motivation when they were in a more positive mood. The secondary block was significant,  $F(5, 113) = 2.89, p = .02$ , and indicated no effect of condition ( $\beta = -.06, t(113) = -0.66, p = .51$ ), but did indicate a significant effect of LI ( $\beta = .27, t(113) = 2.91, p = .004$ ). This latter effect shows that participants who endorsed a greater overlap between mental and physical phenomena were more willing to complete an additional Stroop task. The final block was again significant,  $F(6, 112) = 2.41, p = .03$ , but indicated no interaction between condition and LI ( $\beta = -.03, t(112) = -0.30, p = .77$ ).

## Discussion

The results from Study 4 offer evidence for the importance of contextual information and lay beliefs on both participants' perceptions and participants' performance on a Stroop interference task. Although this task is primarily used as a measure of executive functioning capacity (Kane & Engle, 2003) - and is thus considered primarily mental in nature - its completion appears to be contingent upon both situation-level and individual-level factors relevant to its variable metaphysical nature.

On the situational side, Study 4 showed that participants primed with an article focusing upon the mental (as opposed to physical) experiences of student-athletes showed greater overall performance on the Stroop task - as evidenced by lower overall interference elicited by incongruent trials. The nature of this effect overlaps with that of

Study 2, in which a contextual framing of a handgrip task altered participant performance such that participants performed better (worse) when the framing manipulation emphasized the task's mental (physical) nature. Thus, the present study provides converging evidence for the idea that manipulations emphasizing mental phenomena can promote improved self-control performance, and extends the breadth of this idea to a predominantly mental assessment of self-control. However, it is important to note that the Stroop effects observed in the present work were relatively inconsistent across different metrics, such that the overall influence of the experimental manipulation on Stroop performance was primarily driven by changes in the quality (i.e., Stroop error rate), rather than the speed (i.e., Stroop response latency), of responses. Nonetheless, several studies exploring the effect of particular experimental manipulations on Stroop performance have failed to obtain parallel outcomes on both latency and error metrics (e.g., Dulaney & Rogers, 1994; Kane & Engle, 2003), suggesting that the present findings are representative of the larger literature on Stroop interference.

In addition to identifying an effect of context, the present study also found several effects of the individual difference under study. That is, LI was shown to moderate participants' perceptions of the Stroop task, as well as their motivations concerning past and future Stroop performance. For one, and consistent with the results of Studies 2 and 3, high interactionists were increasingly likely to perceive the self-control task in mental terms. In other words, as participants reported a greater perceived overlap between mental and physical phenomena, they were more likely to perceive the Stroop task as mentally involving. Second, and in contrast to the results of Studies 2 and 3, high interactionists were increasingly likely to report a stronger motivation towards engaging

with the Stroop task, both in a retrospective and prospective sense. That is, high LI participants reported a greater motivation towards completing the Stroop task within the ongoing experimental context, and also reported a stronger motivation to complete an additional Stroop task in a subsequent experimental context (see also Pilot Study 2). One possibility is that endorsing the interrelated nature of mental and physical phenomena affords greater perceptions of efficacy in self-control contexts, such that high interactionists perceive task performance as reliant upon the combined influence of mental and physical capacities (rather than the singular influence of one such capacity), and thus perceive themselves to have more available resources to meet current and future task demands.

### **General Discussion**

The present studies were designed to examine both individual and contextual features with the potential to alter one's subjective, cognitive, and behavioral responding on ostensibly dualistic self-control tasks. Given that self-control is theorized to require a complex combination of mental and physical output (see Inzlicht & Schmeichel, 2012; Kurzban et al., 2013; Molden et al., 2012; Vohs et al., 2012), I reasoned that particular individual differences and experimental manipulations could alter how participants perceive self-control tasks, think about self-control performance, and ultimately behaviorally perform on self-control metrics. In the following sections, I discuss the role of the individual difference factor under study (i.e., lay interactionism), the contextual feature under study (i.e., task framing), and the interaction between these two factors with respect to perceptual, cognitive, and behavioral responding.

#### *The Role of Lay Interactionism*



For one, these studies examined the role of lay interactionism, an individual difference hypothesized to differentiate between people who are more or less likely to perceive interrelations between mental and physical experience. Upon demonstrating the reliability and predictive validity of this index (see Study 1), Studies 2-4 found that LI predicted the extent to which participants perceived a self-control task as physically and mentally engaging. For one, LI consistently correlated with one's conceptualization of a variety of self-control tasks, ranging from handgrip persistence (Study 2), to cold pressor immersion (Study 3), to cognitive inhibition (Study 4), with higher interactionism corresponding with higher perceptions of mental - and to a lesser extent, physical - involvement on self-control tasks (see Table 5). Such findings suggest that greater interactionist beliefs cause individuals to more readily perceive multiple metaphysical aspects of dualistic tasks, and to less readily differentiate between the psychological and physiological requirements of self-control exertion. Furthermore, they suggest that high interactionists have greater awareness of the breadth of challenges associated with self-control output; an awareness that may promote divergent outcomes as a function of whether the individual perceives him/herself as capable of meeting such challenges within a particular context (Clarkson et al., 2010; 2011; Muraven et al., 2008).<sup>6</sup>

Although these differences in task perceptions failed to reliably predict self-control exertion (see Table 6), there exists an array of findings suggesting that particular task perceptions can indeed influence subsequent self-regulatory behavior. For one, research shows that perceptions of energy change associated with a given stimulus predict subsequent behavioral outcomes, such that individuals who anticipate an initial task to elicit energy losses are increasingly sensitive to self-control depletion effects

(Egan, Clarkson, & Hirt, 2015; Job et al., 2010; Martijn et al., 2003; but see Clarkson et al., 2010). However, the present work assessed differences in metaphysical task perceptions (i.e., “Is this task mentally/physically involving?”), rather than differences in energetical task perceptions (i.e., “Is this task depleting/restorative?”), and failed to find a strong correspondence between task perceptions and behavioral exertion. As such, one may conclude that metaphysical task perceptions are (1) less predictive of self-control exertion than are energetical task perceptions, and/or (2) not predictive of self-control exertion when considered orthogonally to energetical task perceptions. This latter possibility can be explored via future studies that manipulate and/or measure both types of task perceptions within a singular experimental design.

In addition to work on the relationship between task perceptions and self-control exertion, there also exists related work concerning the relationship between construal level and self-control exertion. Generally speaking, this work shows that particular construals are most beneficial to self-control when they correspond to the explicit framing of the task, such that framings providing increasingly specific task information benefit participants primed with more concrete construal levels (Egan, Han, & Hirt, 2015; Schmeichel et al., 2012). Because LI alters both physical (i.e., concrete task details) and mental (i.e., abstract task details) task perceptions in the same direction, this individual difference may have failed to predict behavioral self-control because of counteracting influences on construal level. In other words, when individuals perceive a task as more physical *or* mental, differences in self-control behavior may emerge via construal-related processes (Fujita et al., 2006); however, when individuals perceive a task as more

physical *and* mental, these same construal processes may effectively cancel each other out, leading to minimal changes in self-control behavior.

### *The Role of Task Framing*

The present work also attempted to explore situational factors associated with metaphysical task perceptions, and the potential for such factors to impact self-control exertion. That is, Studies 2-4 manipulated particular psychological or psychological information during (Study 2) or prior to (Studies 3-4) a self-control task, and then assessed whether this information predicted one's perceptual, cognitive, or behavioral responses in a self-control context. In line with predictions, Studies 2 and 4 showed that manipulations focusing on psychological constructs led to better overall behavioral performance. For one, attaching electrodes to one's temples led to longer handgrip persistence than did attaching electrodes to one's biceps. Second, reading about the psychological challenges faced by student-athletes led to lesser Stroop interference than did reading about the physiological challenges faced by such athletes. Together, such findings suggest that manipulations which explicitly and/or implicitly emphasize the mental nature of self-control exertion have the potential to benefit behavioral effort exertion on tasks ranging from physiological endurance tests to executive functioning assessments.

In understanding why such effects emerged, Study 2 offers perhaps the most illustrative pattern of evidence. In particular, this study showed that the behavioral influence of the electrode placement manipulation was attributable to changes in one's subjective pain during the handgrip persistence task, such that individuals with electrodes attached to their temples reported less severe increases in pain as their persistence on the

task increased. These findings suggest that the electrode manipulation altered one's conceptualization of an otherwise dualistic concept, in that the experience of pain was less evident, less intense, and/or less problematic when performance was framed in mental - as opposed to physical - terms. Importantly, this pattern implies that subjective experience is a critical mediator of contextual manipulations concerned with altering metaphysical task representations. From this, it follows that if such manipulations are unable to impact one's conceptualization of transient states predictive of task performance (e.g., pain, fatigue, difficulty, motivation), these manipulations should have minimal impact on subsequent behavioral responses. As such, although subjective pain ratings robustly predicted self-control effectiveness in both Studies 2 and 3 (see Table 6), the fact that Study 3's manipulation failed to influence pain ratings may have undermined its potential impact on CPT performance.

#### *The Interaction between LI and Task Framing*

Across Studies 2-4, there was minimal moderation of experimental condition by LI in terms of behavioral self-control. Thus, the self-control exertion of high and low interactionists was relatively equivalent across different task framing conditions. However, there were several notable interactions between LI and experimental condition, the most reliable of which involved task perceptions in Studies 2 and 3. In these studies, LI moderated the contextual manipulation's effect on task perceptions, such that high interactionists were more likely to perceive the self-control task in a manner that contrasted with the intended direction of the task frame. That is, individuals who endorsed greater overlap between mental and physical phenomena were more likely to emphasize the task's mental nature when primed with physical contextual information,

and were more likely to emphasize the task's physical nature when primed with mental contextual information. This pattern of results suggests that high LI individuals more readily elaborate on the metaphysical nature of a given stimulus than do low LI individuals. One explanation for this pattern of findings is that because high LI individuals more readily recognize the physical *and* mental aspects of self-regulatory tasks (see Studies 2-4), manipulations which emphasize one of these aspects causes the activation of additional aspects that allow for a less dualistic conceptualization.

Not only does the above pattern provide some measure of construct validity to the LI index, it also supports the prediction that metaphysical framing manipulations are contingent upon individual differences in metaphysical beliefs (for related findings, see Handley et al., 2009). That is, information intending to distinguish between mental and physical experience is more effective among populations who intuitively support the division between physical and mental experience. It follows that when researchers intend to isolate physiological and psychological processes within particular experimental contexts, it is critical to include participant populations who are cognitively prone to differentiate between these processes. Unfortunately, the present work relied primarily on psychology students as its participant population, and not surprisingly these participants showed relatively polarized beliefs in the overlap between mental and physical processes (see Limitations). Thus, before forming any definitive conclusions about the interaction between LI and metaphysical framing, it is important to obtain participant populations that span the entire continuum of interactionist beliefs.

#### *Future Directions*

Given the relative ease by which individuals bifurcate phenomena into mental and physical subcomponents (Cohen et al., 2011; Dermertzi et al., 2009), as well as the relative wealth of factors which motivate individuals to keep these components distinct (Bloom, 2007), I argue that research into metaphysical framing is a highly viable, practical, and important empirical endeavor. As of yet, there exists little quantitative evidence to inform the psychological and/or behavioral implications of holding particular metaphysical conceptualizations, regardless of whether such conceptualizations are considered at a global level (i.e., individual differences in belief systems) or a contextual level (i.e., manipulations emphasizing a phenomenon's mental/physical nature). I argue that the present work serves as a viable starting point to begin exploring the consequences of metaphysical perceptions; perceptions that likely hold relevance both inside and outside the domain of self-control exertion.

One arena in which metaphysical perceptions can be fruitfully examined is within the research on human effort exertion. Much empirical work has concerned itself with the study of concrete physiological processes that emerge before, during, and after instances of effortful responding. Examples of these processes include systolic blood pressure (Wright & Gendolla, 2012), heart rate (Turner et al., 1999), pupil dilation (Van Gerven, Paas, Van Merrienboer, & Schmidt, 2004), cortisol (Neupert, Soederberg, & Lachman, 2006), blood glucose (Galliot & Baumeister, 2007), cortical recruitment breadth (Park & Reuter-Lorenz, 2009), and neuroanatomical reactivity (Heatherton & Wagner, 2011). Among this wealth of empirical findings, there is a dearth of programmatic research into whether these measurement techniques alter perceptual, cognitive, and/or behavioral responding. Following from the present studies, I argue researchers who measure these

types of physiological responses should also attempt to understand how their methods impact the participant's metaphysical perceptions of the phenomenon under study. To achieve this aim, researchers can include additional comparison conditions, such as those that utilize different *amounts* of equipment (e.g., minimal, moderate, high), differential *information* about the equipment's nature (e.g., psychological, physiological, neutral), and differential *contexts* in which the equipment is embedded (e.g., medical lab, psychological lab, plain room). While such comparisons fall outside the scope of many scientist's primary interests, they nonetheless would provide a clearer picture of how participants conceptualize their responding, as well as how such conceptualizations impact subsequent cognitive and behavioral outcomes.

In addition to its applicability towards effort exertion, the perceived distinction between physical and mental phenomena allows for the assessment of novel research questions within numerous other areas of psychological science. Given the increasing number of psychological domains in which human behavior is theorized to change via both physiological and psychological mechanisms, there exists increasing opportunities for researchers to understand how the relative emphasis of particular mechanisms impacts perceptual, cognitive, and behavioral outcomes. As but one example, social and cognitive psychologists have identified an array of processes underlying the generation and modulation of human attitudes (Ajzen & Fishbein, 1977; Amodio et al., 2004; Fazio & Towles-Schwen, 1999; Greenwald, McGhee, & Schwartz, 1998; Judd, Drake, Downing, & Krosnick, 1991; Phelps et al., 2000), ranging from those implicating primarily psychological processes (e.g., semantic networks) to those implicating primarily physiological processes (i.e., neurological activity). Although these processes clearly

interact with one another to form complex theoretical possibilities, their perceptual distinctiveness from one another allows researchers to explore how particular metaphysical representations of human attitudes impact attitudinal processes (e.g., attitude malleability, intentions to overcome bias, punishment of biased individuals, befriending outgroup individuals). Specifically, researchers can utilize differential task framings (e.g., information about an IAT assessment), differential measurement techniques (e.g., bodily or brain responses), or individual differences (e.g., metaphysical beliefs) to elucidate whether one's metaphysical perceptions of attitudes vary systematically, as well as whether systematic differences in such perceptions impact corresponding cognitions and behavior.

While the previous discussion offers several domains in which metaphysical perceptions can impact human responding (e.g., effort exertion, attitudinal processes), it is equally important to consider whether these perceptions are more or less malleable within particular participant populations, as well as among particular psychological processes. Within the introduction of the present work, I offered several global-level (e.g., religion, healthcare) and individual-level (e.g., existential anxiety, human uniqueness) factors that may motivate individuals to adhere to a dualistic perspective in the face of conflicting scientific evidence. As such, it is possible that some individuals will exhibit psychological reactance to information implying that their personal experience is governed by predominantly physiological factors. For instance, religious populations may question whether physiological processes govern self-control, given that such populations associate self-control with underlying spiritual conviction. If reactance is a pronounced possibility, researchers could allow participants to affirm their core



beliefs prior to implementing information suggestive of physicalistic perspectives towards human experience (Cohen & Sherman, 2014).

### *Implications*

At a general level, the notion of physical and mental foci as malleable mindsets allows empirical approaches to compare and contrast the psychological, cognitive, and behavioral benefits associated with particular foci within particular social contexts. While it remains to be seen whether such mindsets consistently alter participant responding across diverse contexts, the ubiquity of dualistic belief systems offers the possibility to begin exploring differences in psychological outcomes as a function of metaphysical representations. Below I outline several domains in which metaphysical beliefs hold important implications for human psychology, and discuss how the present work informs research within these domains.

One arena in which perceptions of physical and mental involvement vary as a function of contextual and individual factors is human health. Specifically, when individuals succumb to a given health ailment, different types of cultures (e.g., Eastern vs. Western medicine), doctors (e.g., physicians vs. psychiatrists), and individuals (e.g., religious vs. non-religious) are likely to attribute this ailment to different metaphysical forces (Freedland, Miller, & Sheps, 2006; Lane & Wager, 2009; Park, 2013; Suls, Luger, & Martin, 2010). Following from the present work, several conclusions can be garnered concerning the effects of metaphysical attributions on particular health outcomes. For one, these attributions may alter the methods used to diagnose, monitor, and treat health ailments, such that doctors place more emphasis on physiological - as opposed to psychological - measurement techniques when a health ailment is perceived in primarily

physical terms. Second, these attributions can alter the perceptions and behaviors of individuals attempting to regulate health ailments in their personal life, such that patients have higher efficacy expectations towards pharmaceutical - as opposed to psychiatric - treatment when a health ailment is perceived in primarily physical terms. Finally, these attributions can alter the stigmatization associated with particular health outcomes, such that individuals who suffer from a given ailment may be perceived less favorably when this ailment is presumed to rely upon physical processes. Following from these possibilities, researchers interested in understanding psychological and behavioral responses to multiply-determined health ailments (e.g., obesity, memory loss) will benefit from increased consideration of contextual and individual features that promote particular metaphysical representations of these ailments.

Another arena in which metaphysical representations hold considerable implications for human responding is within the domain of spiritual beliefs. In particular, the present findings concerning the self-regulatory benefits of a mental focus share considerable overlap with work on the self-regulatory benefits of meditative and religious practice. For one, a broad body of literature indicates that mindfulness meditation techniques (i.e., intensive focus on a particular aspect of one's subjective experience) increase human self-control in myriad contexts (Bowlin & Baer, 2012; Frieze, Messner, & Schaffner, 2012; Grossman, Niemann, Schmidt, & Walach, 2004; Masicampo & Baumeister, 2007; Lengacher et al., 2009; 2012; Witkiewitz, Marlatt, & Walker, 2005; Zainal, Booth, & Huppert, 2012). In explaining this relationship, one possibility is that mindful individuals frame self-control conflicts in increasingly mental terms, and these polarized conceptualizations promote subsequent self-control exertion (see Studies 2 and

4). An additional possibility is that individuals experienced with mindfulness techniques hold higher perceptions of self-efficacy towards difficult mental tasks, which could independently promote task success and/or interact with metaphysical task representations to elicit particularly pronounced self-control effectiveness. Such possibilities also apply to the positive relationship observed between religiosity and self-control, in which individual and situational differences that promote religious thinking increase self-control exertion (Friese & Wänke, 2014; McCullough & Willoughby, 2009; Rounding, Lee, Jacobson, & Ji, 2012). That is, religious individuals may perceive self-control tasks in more mental/spiritual terms than their less religious counterparts, as well as hold higher perceptions of self-efficacy and motivation towards tasks framed in these terms; either of which offers a psychological pathway by which spiritual beliefs can benefit self-regulatory effectiveness.

A third arena in which metaphysical perceptions can impact human performance is within the domain of sport. While conventional dualistic beliefs may promote the dichotomization of sport into physiological (e.g., fitness, technique) and psychological (e.g., focus, dedication) constructs, it remains to be seen how this type of dichotomy is endorsed and enacted in various sporting populations. Given that mental fatigue can affect physiological performance (Bray et al., 2012; Dorris, Power, & Kenefick, 2012; Egan, Riley, Hirt, Ekert, & Koceja, 2014) and that physical fatigue can undermine cognitive performance (Chang, Labban, Gapin, & Etnier, 2012), athletes would appear to represent a population in which personal experience catalyzes greater belief in the overlap between physical and mental experiences. Following from the present work, it is possible that an association between athletic experience and physicalistic beliefs leads to

corresponding effects on one's perceptions of sport performance, such that highly experienced athletes more readily attend to both the mental and physical challenges associated with extensive/intense athletic engagement. As of yet, it remains to be seen whether different types of athletic populations show differential metaphysical perceptions of the same athletic construct (e.g., fatigue) or athletic task (e.g., endurance running), as well as whether these potential differences influence preparation, execution, and/or evaluations of athletic performance. Nonetheless, because sport operates at the intersection of physical and mental performance, I argue that research in this domain will benefit from the inclusion of metaphysical measurements at both the global (i.e., lay interactionism) and local (i.e., task perceptions) level.

### *Limitations*

Although the present work obtained several intriguing patterns of findings, it is important to recognize the methodological and theoretical limitations of my approach. For one, the manipulations utilized in the present work were relatively ineffective in altering participants' perceptions of the dependent measures under study. That is, even with pilot testing suggesting that the electrode placement and article prime manipulations could alter metaphysical task perceptions (see Appendix 1, Pilot Studies 2-3), these manipulations did not consistently alter such conceptualizations within the primary experimental studies (but see Study 2). As such, the obtained differences in self-control performance across experimental conditions are difficult to attribute solely to explicit task perceptions. When conducting future work on the differences between physical and mental task conceptualizations, it is critical to utilize manipulations that most effectively vary such conceptualizations across the entirety of potential participants. Insofar as such

methods limit demand characteristics, I recommend that researchers include manipulations with both contextual (e.g., electrode placement) and verbal (e.g., task instructions) components in order to achieve the highest probability of altering participant perceptions in the intended direction. In addition, future work may benefit from the utilization of novel contextual variations, some of which have already been explored in related research domains. For instance, visual cues have been demonstrated to manipulate one's perceptions of target individuals, such that images focusing on a target's body predict heightened attention towards the target's physical states (Gervais, Holland, & Dodd, 2013; Gray et al., 2011; Loughnan et al., 2010).

In addition to the manipulations under study, there also exist concerns about the behavioral tasks utilized subsequent to these manipulations. Indeed, the perceptual data from Studies 2-4 indicate that each self-control task was perceived in a relatively distinct fashion, such that the handgrip task was perceived to be closest to the intersection of mind and body involvement, whereas the CPT task and the Stroop task were perceived to be closer to the mental end of the perceptual continuum. As such, although I obtained evidence that a mental task framing improved handgrip persistence and Stroop performance relative to a physical task framing, these patterns of findings are potentially contingent upon the correspondence between task perceptions and the contextual manipulation under study. For instance, if Study 2 had utilized a task that was perceived as more mentally than physically involving (e.g., CPT, Stroop), the effectiveness of the manipulation under study may have been dampened. As such, it is critical for future work to assess the compatibility between different experimental tasks and different task

framing manipulations, such that researchers are able to identify the contextual features most central to modulating task perceptions within specific experimental contexts.

There also exist limitations concerning the primary individual difference under study. That is, although the LI index offered measures of scalar consistency (Studies 1-4), construct validity (Study 1), and predictive validity (Studies 2-4), this index's statistical distribution was potentially problematic. Across all studies, the standard deviation of this index was relatively low in comparison to the other individual difference measures utilized, implying that underlying differences in metaphysical perspective were quite small across participants.<sup>8</sup> This lack of statistical variability likely constrained LI's predictive validity towards the perceptual and performance outcomes assessed within the present studies. However, before concluding that this index requires substantial revision, it is important to explore its variability across a greater range of participants. That is, because all participants within the present studies were obtained from the psychology department of a liberal arts university, the variability measures under consideration may be artificially constrained due to underlying participant factors (e.g., age, education, SES, culture). Thus, broadening the scope of participant recruitment remains an important goal for future research on LI, particularly in terms of obtaining a greater range of educational interests, cultural backgrounds, and geographical locations.

Finally, although the present work obtained evidence supporting the benefits of mental task conceptualizations in the domain of self-control effectiveness, it is possible that the relationship between task conceptualization and task performance is contingent upon transient psychological and physiological factors. For one, online perceptions of energy availability may moderate the effect of metaphysical task perceptions, such that

individuals who perceive themselves as particularly physically energized should be more likely to exhibit self-regulatory improvements following manipulations that prime physical task conceptualizations. Additionally, there exists some work suggesting that contextual cues associated with heightened bodily awareness (e.g., sitting upright, Riskind, 1984; inhibiting urination, Tuk, Trampe, & Warlop, 2011; clenching one's fist, Hung & Labroo, 2011) can catalyze improved cognitive control. As such, embodied manipulations of physiological engagement may moderate the effects of metaphysical task conceptualizations, such that individuals whose body is in an active state should be more likely to exhibit self-regulatory improvements following manipulations that prime physical task conceptualizations. Both of the above possibilities emphasize the importance of an individual's transient state (i.e., perceived energy, embodied postures) in forming more generalizable conclusions about the relationship between metaphysical perceptions and self-regulatory exertion.

### *Conclusion*

By exploring the effects of individual and contextual features on the conceptualization and enactment of self-control behavior, the present work represents a novel effort to combine philosophy and psychology to understand how metaphysical beliefs impact human performance. While preliminary, the present findings inform researchers interested in studying a wide array of psychophysiological outcomes using a broad diversity of methods. As scientists continue to explore the frontiers of physiological and neurological measurement, it is important not only to understand what these measures assess, but also how they are perceived. Regardless of whether physiological or psychological responses provide more generative, objective, or

important data, exploring how people think about these responses can help philosophers, psychologists, and physiologists better understand the factors underlying particular cognitive and behavioral responses.



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### Footnotes

1. In addition to serving motivational needs, it can be argued that dualistic beliefs also serve cognitive efficiency needs for the individual. Classic research suggests that humans commonly engage in categorical thinking as a means to limit cognitive processing demands in their everyday lives (Macrea & Bodenhausen, 2000; Macrae, Milne, & Bodenhausen, 1994), such that they divide a continuous set of stimuli into a smaller subset of categories, and then utilize these categories to make judgments about individual cases encountered within this stimulus set. Mind-body dualism represents a prototypical example of categorical thinking, such that dualists dichotomize a continuous perceptual space into mental and physical constructs. Given that this dichotomization corresponds to human subjective experience (Bloom, 2007), this form of categorical thinking may minimize the cognitive requirements necessary to understand and predict complex behavior in an online fashion.

2. In addition to informing the hypotheses of the present work, these findings suggest two additional possibilities concerning the origins of dualistic thinking. For one, individuals may be inherently predisposed to endorse this type of categorical thought, given that their physiological system responds differentially to primarily physical and primarily mental stimuli. Second, dualistic thinking, initially socialized from particular cultural institutions, may lead individuals to respond differentially to stimuli that would otherwise activate similar physiological systems. In either case, distinguishing between mental and physical components appears to be the “default” mode of metaphysical thought within many human populations.

3. Control condition participants did not receive any information about this electrical data, but the equipment to collect such data was nonetheless present in their cubicle.

4. Consistent with its presumed theoretical relevance to self-control performance, results indicated that pain slope was the most effective predictor of handgrip persistence within the available pain metrics within Study 2. For one, when included within individual regression equations, pain slope significantly predicted handgrip persistence ( $\beta = -.42$ ,  $t(114) = -4.90$ ,  $p < .001$ ), whereas other pain-related metrics did not (final pain rating -  $\beta = .16$ ,  $t(114) = 1.80$ ,  $p = .07$ ; average pain score -  $\beta = .03$ ,  $t(114) = 0.32$ ,  $p = .75$ ). Additionally, when all of these metrics were included simultaneously to predict handgrip persistence, the effect of pain slope was the most pronounced (final pain rating -  $\beta = 1.04$ ,  $t(112) = 7.06$ ,  $p < .001$ ; average pain score -  $\beta = -.69$ ,  $t(112) = -4.87$ ,  $p < .001$ ; pain slope -  $\beta = -.69$ ,  $t(112) = -8.59$ ,  $p < .001$ ).

5. While it is possible to remove all participants from analysis who persisted for 5 min, doing so was deemed problematic for several reasons. For one, there was no reliable difference in the number of participants who persisted for 5 min as a function of condition (Condition 1 = 13, Condition 2 = 7, Condition 3 = 13;  $\chi^2 = 3.31$ ,  $p = .19$ ) or LI ( $r = .07$ ,  $p = .46$ ). Second, removing these participants would cause the statistical power of experiment to be relatively inadequate, especially when considering any potential moderating influences of LI. Third, the pattern of results remains unchanged regardless of whether these participants are included within the general dataset, suggesting that the inclusion of this subgroup does not significantly alter the findings under consideration. Fourth, I was not able to find any CPT studies that have explicitly removed participants

for meeting or exceeding a predetermined persistence limit. Fifth, and perhaps most importantly, the participants who persisted to the maximum temporal threshold represent a theoretically meaningful participant group, as a primary intention of the present work is to understand the factors that promote prolonged self-control persistence. For all of these reasons, I chose to retain this subgroup of participants within the analyses reported in the main text.

6. Although this possibility was not examined in the present work, future research may benefit from examining changes in perceived depletion as a function of task engagement and LI. That is, if high LI individuals perceive themselves to have a greater wealth of resources to meet particular task demands, they may show less evidence of perceived mental or physical depletion after completing a highly effortful cognitive/behavioral task.

7. In this study, CPT persistence was at its lowest level among participants who were exposed to a psychological-frame manipulation; a finding that directly conflicts with the pattern identified in Study 4. Because Studies 3 and 4 utilized the same experimental manipulation but obtained highly discrepant results, it is possible that the manipulation's effect on performance is dependent upon particular features of the self-control task it precedes. For example, because task perception data indicates that the Stroop was perceived as more mentally involving than was the CPT, the article prime manipulation may be more impactful on tasks that are perceived in relatively polarized terms. That is, focusing on the mental nature of self-control could have a more positive impact on behavioral exertion when the self-control task is perceived as reliant upon mental processes. For the CPT task, in which prolonged persistence is contingent upon a



relatively greater number of physiological processes (e.g., hand pain, tissue damage), focusing on mental constructs may have proven substantially less beneficial. Additional possibilities for the lack of effects in Study 3 involve methodological and practical concerns, such as the polarized nature of the CPT data and the health concerns that the CPT paradigm elicited, either of which could have diminished any systematic differences in persistence across conditions.

8. While problematic, this observation supports the hypothesized role of LI in governing perceptual reactions to dualistic tasks. That is, if relatively small differences in LI reliably predict task perceptions in multiple data collections (see Studies 2-4), one can anticipate that relatively large differences in LI will reinforce these initial patterns. This possibility also helps to explain the relatively low efficacy of the experimental manipulations in altering task perception metrics. Specifically, because the response range of this index was restricted to relatively high responses (i.e., responses above the scalar midpoint), these experiments lacked the sub-population for which the contextual manipulations were presumed to have their strongest effects (i.e., among low LI individuals).

Table 1. Pairwise Correlations from Study 1.

	LI	LTW	TSC	SCE	SCSM	CSE	FW	CT	FI	CN	PBC	REL	MBD	MPO	PT	LTI	GRT	ASW	NCG	NCL	PSC	SH	WRK	SE	SM	OPN	CON	EXT	AGR	NRT
Lay Interactionism																														
Lay Theory of Willpower	.13																													
Trait Self-Control	.00	-.15 <sup>†</sup>																												
Self-Control as Energy	.24 <sup>***</sup>	.38 <sup>***</sup>	-.27 <sup>***</sup>																											
Self-Control as State of Mind	.25 <sup>***</sup>	-.26 <sup>***</sup>	.23 <sup>***</sup>	.00																										
Generalized Self-Efficacy	.25 <sup>***</sup>	-.06	.33	-.05	.60 <sup>***</sup>																									
Free Will	.13	-.06	.17 <sup>†</sup>	-.10	.39 <sup>***</sup>	.53 <sup>***</sup>																								
Categorical Thinking	-.02	-.11	.13	.07	.15 <sup>†</sup>	.12	.27 <sup>***</sup>																							
Faith in Intuition	.11	-.07	.02	.00	.28 <sup>***</sup>	.32 <sup>***</sup>	.20 <sup>†</sup>	.21 <sup>†</sup>																						
Connectedness to Nature	.15 <sup>†</sup>	-.10	.04	.07	.14	.17 <sup>†</sup>	.04	.00	.05																					
Private Body Consciousness	.28 <sup>***</sup>	.23 <sup>***</sup>	-.16 <sup>†</sup>	.20 <sup>†</sup>	.14	.09	-.10	-.08	.24 <sup>***</sup>	.08																				
Religiosity	.11	-.03	-.06	-.08	.13	.01	.18 <sup>†</sup>	.31 <sup>***</sup>	.01	-.01	-.01																			
Mind-Body Dualism	.21 <sup>†</sup>	.12	.00	.01	.13	.09	.21 <sup>†</sup>	.14	.13	.02	-.01	.38 <sup>***</sup>																		
Mental-Physical Overlap	.55 <sup>***</sup>	-.12	-.01	.13	.14	.19 <sup>†</sup>	-.01	.14	.26 <sup>***</sup>	.15 <sup>†</sup>	.17 <sup>†</sup>	.14	.19 <sup>†</sup>																	
Perspective-Taking	.27 <sup>***</sup>	-.05	.04	.01	-.03	.16 <sup>†</sup>	.10	-.15 <sup>†</sup>	-.01	.15 <sup>†</sup>	-.01	.08	.06	.15 <sup>†</sup>																
Lay Theory of Intelligence	.21 <sup>†</sup>	-.07	.05	-.23 <sup>***</sup>	.02	-.04	-.14	-.10	-.04	-.07	.17 <sup>†</sup>	.04	.28	.08																
Grit	-.03	-.04	.50 <sup>***</sup>	.19 <sup>†</sup>	.34 <sup>***</sup>	.43 <sup>***</sup>	.25 <sup>***</sup>	.10	.09	-.16 <sup>†</sup>	-.03	.03	.08	-.05	.05															
Academic Contingencies of Self-Worth	.42 <sup>***</sup>	.15 <sup>†</sup>	.06	.16 <sup>†</sup>	.09	.10	-.15 <sup>†</sup>	-.15 <sup>†</sup>	-.03	.02	.29 <sup>***</sup>	-.10	-.06	.14	.19 <sup>†</sup>	.17 <sup>†</sup>	.08													
Need for Cognition	.31 <sup>***</sup>	-.32 <sup>***</sup>	.25 <sup>***</sup>	-.14	.37 <sup>***</sup>	.40 <sup>***</sup>	.18 <sup>†</sup>	-.06	.11	.24 <sup>***</sup>	-.01	-.06	.05	.28	.27 <sup>***</sup>	.13	.14	.10												
Need for Closure	.10	.25 <sup>***</sup>	.10	.21 <sup>†</sup>	.04	-.01	.12	.09	-.05	-.16 <sup>†</sup>	-.10	-.06	.04	-.10	-.27 <sup>***</sup>	.02	.27 <sup>***</sup>	.22 <sup>***</sup>	.22 <sup>***</sup>											
Private Self-Consciousness	.26 <sup>***</sup>	.03	-.01	.05	.18	.14	-.12	-.18 <sup>†</sup>	.15 <sup>†</sup>	.08	.25 <sup>***</sup>	-.07	.06	.16 <sup>†</sup>	.18 <sup>†</sup>	.21 <sup>†</sup>	-.01	.13	.23 <sup>***</sup>	.04										
Self-Handicapping	-.23 <sup>***</sup>	.14	-.56 <sup>***</sup>	.35 <sup>***</sup>	-.40 <sup>***</sup>	-.46 <sup>***</sup>	-.34 <sup>***</sup>	.02	-.12	-.08	.14	-.06	-.10	-.15 <sup>†</sup>	-.10	-.17 <sup>†</sup>	-.54 <sup>***</sup>	-.03	-.36 <sup>***</sup>	-.13	-.06									
Worker Scale	.41 <sup>***</sup>	.15 <sup>†</sup>	.23 <sup>***</sup>	.08	.30 <sup>***</sup>	.43 <sup>***</sup>	.15 <sup>†</sup>	.03	.15 <sup>†</sup>	.16 <sup>†</sup>	.20 <sup>†</sup>	.07	.21 <sup>†</sup>	.22 <sup>***</sup>	.15 <sup>†</sup>	.03	.36 <sup>***</sup>	.31 <sup>***</sup>	.13	.26 <sup>***</sup>	.21 <sup>†</sup>	-.36 <sup>***</sup>								
Self-Esteem	.11	.17 <sup>†</sup>	.33 <sup>***</sup>	-.27 <sup>***</sup>	.19 <sup>†</sup>	.39 <sup>***</sup>	.31 <sup>***</sup>	.08	.15 <sup>†</sup>	-.02	-.19 <sup>†</sup>	.11	-.05	.11	.12	.04	.29 <sup>***</sup>	-.10	.27 <sup>***</sup>	-.09	.16 <sup>†</sup>	-.56 <sup>***</sup>	.15 <sup>†</sup>							
Self-Monitoring	.12	-.11	-.12	.07	.03	-.03	-.04	-.07	.02	.08	-.18 <sup>†</sup>	.00	.10	.08	.11	-.11	-.14	.02	.11	-.13	.01	.06	.06	-.04						
Openness to Experience	.05	-.19 <sup>†</sup>	.20 <sup>†</sup>	-.08	.19 <sup>†</sup>	.32 <sup>***</sup>	.08	-.09	.15	.41 <sup>***</sup>	.03	-.07	.10	.14	.26 <sup>***</sup>	-.06	.03	-.10	.55 <sup>***</sup>	-.37 <sup>***</sup>	.23 <sup>***</sup>	-.21 <sup>†</sup>	.06	.22 <sup>***</sup>	.09					
Conscientiousness	.01	.07	.44 <sup>***</sup>	-.19 <sup>†</sup>	.12	.37 <sup>***</sup>	.25 <sup>***</sup>	.08	.04	-.03	-.06	-.08	.10	-.05	.11	-.06	.59 <sup>***</sup>	.27 <sup>***</sup>	.03	.30 <sup>***</sup>	-.09	.44 <sup>***</sup>	.36 <sup>***</sup>	.17 <sup>†</sup>	-.09	.03				
Extraversion	.09	-.12	-.01	-.10	.26 <sup>***</sup>	.31 <sup>***</sup>	.22 <sup>***</sup>	.22 <sup>***</sup>	.05	.16 <sup>†</sup>	.15 <sup>†</sup>	.08	.07	.04	.09	.07	.10	-.02	-.08	-.25 <sup>***</sup>	.27 <sup>***</sup>	.42 <sup>***</sup>	.31 <sup>***</sup>	.11	.08					
Agreeableness	.01	-.01	-.03	-.09	-.07	-.04	.09	-.14	-.14	.04	-.04	.19 <sup>†</sup>	.07	-.05	.46 <sup>***</sup>	.06	.14	.02	-.06	-.12	-.06	-.16 <sup>†</sup>	.17 <sup>†</sup>	.11	.06	.03	.19 <sup>†</sup>	.07		
Neuroticism	.05	.21 <sup>†</sup>	-.16 <sup>†</sup>	.37 <sup>***</sup>	-.12	-.21 <sup>†</sup>	-.28 <sup>***</sup>	-.10	.01	.06	.20 <sup>†</sup>	-.28 <sup>***</sup>	.06	.07	-.06	-.03	-.28 <sup>***</sup>	.26 <sup>***</sup>	-.14	.19 <sup>†</sup>	.12	.44 <sup>***</sup>	.02	-.45	.02	-.11	-.06	-.22 <sup>***</sup>		

Note.  $N = 126$ . <sup>†</sup>  $p < .10$ . <sup>\*</sup>  $p < .05$ . <sup>\*\*</sup>  $p < .01$

Table 2. Descriptive Statistics from Studies 2-4

		BX	PS	MENT	PHYS	MVP	DIFF	RMOT	PMOT	LI	LTW	TSC	MPO
Study 2 - Handgrip (N = 123)	M	106.13	.043	6.59	6.60	4.61	6.82	7.33	5.55	5.56	4.55	4.59	5.34
	SD	53.83	.017	1.45	1.27	1.69	1.43	1.14	2.30	0.58	1.22	0.97	0.99
Study 3 - CPT (N = 107)	M	169.98	.033	6.27	3.77	2.93	4.85	6.29	5.51	5.03	4.26	4.08	4.80
	SD	105.24	.026	1.48	1.86	1.95	2.19	1.94	2.54	0.67	1.18	0.89	1.10
Study 4 - Stroop (N = 179)	M	57.67	---	6.49	4.37	2.70	4.62	6.36	5.33	5.38	4.73	4.27	5.05
	SD	50.34	---	1.47	1.65	1.68	1.66	1.62	2.43	0.70	1.03	0.98	1.03

Notes. BX = primary behavioral self-control measurement in each study; Study 4 lists Stroop latency interference,

PS = pain slope, MENT = mental perceptions, PHYS = physical perceptions, MVP = mental-versus-physical,

DIFF = perceived difficulty, RMOT = retrospective motivation, PMOT = prospective motivation,

LI = lay interactionism, LTW = lay theory of willpower, TSC = trait self-control, MPO = mental-physical overlap

Pain slope was not assessed in Study 4.

Table 3. Descriptive Statistics as a Function of Experimental Condition, Studies 2-4

		BX	PS	MENT	PHYS	MVP	DIFF	RMOT	PMOT
Study 2 (Handgrip)	Mental ( $n = 40$ )	131.00 (59.70)	.038 (.015)	6.60 (1.31)	6.52 (1.23)	4.75 (1.34)	6.68 (1.47)	7.24 (0.99)	5.33 (2.59)
	Physical ( $n = 41$ )	103.39 (52.37)	.046 (.017)	6.63 (1.52)	6.71 (1.41)	4.63 (1.62)	7.06 (1.25)	7.26 (1.32)	5.59 (2.32)
	Control ( $n = 42$ )	85.12 (38.63)	.045 (.019)	6.54 (1.53)	6.57 (1.17)	4.45 (2.05)	6.73 (1.54)	7.48 (1.09)	5.74 (2.00)
Study 3 (CPT)	Mental ( $n = 36$ )	143.75 (98.59)	.035 (.023)	6.28 (1.22)	3.51 (1.73)	2.69 (1.79)	5.11 (1.95)	6.39 (1.59)	5.11 (2.71)
	Physical ( $n = 36$ )	173.28 (112.07)	.032 (.028)	6.49 (1.73)	3.53 (1.87)	3.19 (2.32)	5.14 (2.43)	6.25 (2.27)	5.81 (2.79)
	Control ( $n = 35$ )	193.57 (101.37)	.031 (.026)	6.03 (1.47)	4.27 (1.95)	2.89 (1.71)	4.29 (2.12)	6.23 (1.94)	5.63 (2.06)
Study 4 (Stroop)	Mental ( $n = 60$ )	51.93 (46.55)	---	6.42 (1.60)	4.32 (1.76)	2.70 (1.73)	4.48 (1.90)	6.29 (1.63)	5.20 (2.46)
	Physical ( $n = 59$ )	60.14 (54.01)	---	6.83 (1.19)	4.44 (1.70)	2.68 (1.66)	4.70 (1.58)	6.47 (1.75)	5.36 (2.38)
	Control ( $n = 60$ )	60.98 (50.60)	---	6.23 (1.53)	4.34 (1.51)	2.72 (1.69)	4.68 (1.49)	6.32 (1.50)	5.43 (2.47)

Notes. Values represent mean response, with standard deviation in parentheses.

BX = primary behavioral self-control measurement in each study; Study 4 = Stroop latency interference,

PS = pain slope, MENT = mental perceptions, PHYS = physical perceptions, MVP = mental-versus-physical,

DIFF = perceived difficulty, RMOT = retrospective motivation, PMOT = prospective motivation,

LI = lay interactionism, LTW = lay theory of willpower, TSC = trait self-control, MPO = mental-physical overlap

Pain slope was not assessed in Study 4.

Table 4. Regression Results from Studies 2-4

		BX			PS			MENT			PHYS			MVP			DIFF			RMOT			PMOT		
		$\beta$	F	$\Delta R^2$	$\beta$	F	$\Delta R^2$	$\beta$	F	$\Delta R^2$	$\beta$	F	$\Delta R^2$	$\beta$	F	$\Delta R^2$	$\beta$	F	$\Delta R^2$	$\beta$	F	$\Delta R^2$	$\beta$	F	$\Delta R^2$
Study 2	Step 1	.22 <sup>*</sup>	2.24 <sup>*</sup>	.05	-.28 <sup>*</sup>	1.73	.09	-.09	1.47	.03	-.06	0.48	.00	.14	2.88 <sup>*</sup>	.06	-.16	1.51	.03	-.02	0.26	.01	-.07	0.22	.01
	LI	.05	---	---	.18	---	---	.18	---	---	-.03	---	---	-.25 <sup>*</sup>	---	---	-.04	---	---	.09	---	---	.06	---	---
Study 3	Step 1	.13	0.92	.04	.04	0.39	.00	-.11	2.58 <sup>*</sup>	.09	-.04	1.11	.04	-.13	1.73	.02	-.05	1.85	.03	.04	0.39	.02	-.11	1.82	.02
	LI	.17	---	---	-.02	---	---	.31 <sup>*</sup>	---	---	.20	---	---	-.08	---	---	-.16	---	---	.13	---	---	.09	---	---
Study 4	Step 1	-.17 <sup>f</sup>	1.33	.03	---	---	---	-.20 <sup>*</sup>	7.78 <sup>**</sup>	.14	-.04	0.54	.00	.01	1.05	.04	-.06	2.41 <sup>*</sup>	.01	-.08	5.82 <sup>**</sup>	.04	-.06	2.89 <sup>*</sup>	.07
	LI	-.03	---	---	---	---	---	.35 <sup>*</sup>	---	---	.04	---	---	-.20 <sup>*</sup>	---	---	.12	---	---	.20 <sup>*</sup>	---	---	.27 <sup>**</sup>	---	---
Step 2	Condition x LI	-.08	1.22	.01	---	---	---	-.02	6.44 <sup>**</sup>	.00	.13	0.74	.02	.04	0.89	.00	-.05	2.05 <sup>f</sup>	.00	-.15 <sup>f</sup>	5.44 <sup>**</sup>	.02	-.03	2.41 <sup>*</sup>	.00

Notes. <sup>f</sup>  $p \leq .10$  \*  $p \leq .05$  \*\*  $p \leq .01$ .

Condition: 1 = Mental, 0 = Neutral, -1 = Physical.

BX = primary behavioral self-control measurement in each study; Study 4 = overall Stroop performance.

PS = pain slope, MENT = mental perceptions, PHYS = physical perceptions, MVP = mental-versus-physical.

DIFF = perceived difficulty, RMOT = retrospective motivation, PMOT = prospective motivation.

LI = lay interactionism

Table 5. Pairwise Correlations from Studies 2-4

	LI	LTW	TSC	MPO	MD	DIF	MNT	PHY	MVP	RMT	PMT	ART
Lay Interactionism	---	---	---	---	---	---	---	---	---	---	---	---
Lay Theories of Willpower	.06	---	---	---	---	---	---	---	---	---	---	---
Trait Self-Control	.13 <sup>**</sup>	-.13 <sup>***</sup>	---	---	---	---	---	---	---	---	---	---
Mental-Physical Overlap	.30 <sup>**</sup>	.05	.03	---	---	---	---	---	---	---	---	---
Mood	.11 <sup>*</sup>	-.17 <sup>**</sup>	.28 <sup>**</sup>	-.03	---	---	---	---	---	---	---	---
Perceived Difficulty	.13 <sup>**</sup>	.08	.05	.04	-.03	---	---	---	---	---	---	---
Mental Perceptions	.35 <sup>**</sup>	.15 <sup>***</sup>	.04	.13 <sup>***</sup>	.12 <sup>*</sup>	.35 <sup>***</sup>	---	---	---	---	---	---
Physical Perceptions	.19 <sup>**</sup>	.09 <sup>†</sup>	.13 <sup>*</sup>	.12 <sup>*</sup>	.03	.52 <sup>**</sup>	.20 <sup>**</sup>	---	---	---	---	---
Mental vs. Physical Perceptions	-.07	.00	.04	-.01	-.05	.29 <sup>**</sup>	-.20 <sup>**</sup>	.53 <sup>***</sup>	---	---	---	---
Retrospective Motivation	.21 <sup>**</sup>	.02	.07	.10 <sup>*</sup>	.17 <sup>**</sup>	.27 <sup>***</sup>	.43 <sup>***</sup>	.27 <sup>***</sup>	.11 <sup>*</sup>	---	---	---
Prospective Motivation	.17 <sup>**</sup>	-.03	.12 <sup>*</sup>	.05	.17 <sup>**</sup>	-.09 <sup>†</sup>	.08 <sup>†</sup>	-.01	-.07	.22 <sup>**</sup>	---	---
Article Perceptions	.18 <sup>**</sup>	.07	.10 <sup>†</sup>	.04	.08	.02	.13 <sup>*</sup>	.05	-.01	.12 <sup>*</sup>	.13 <sup>*</sup>	---

Notes.  $N = 409$  for all measures, except Article Perceptions ( $N = 286$ ).

<sup>†</sup>  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$

Table 6. Predictors of Self-Control Performance in Studies 2-4

	Study 2		Study 3		Study 4	
	$\beta$	$p$	$\beta$	$p$	$\beta$	$p$
Pain Slope	-.423	.01	-.519	.01	---	---
Mental Perceptions	.150	.16	-.012	.88	-.097	.32
Physical Perceptions	.030	.80	.083	.24	-.052	.55
Mental vs. Physical Perceptions	.053	.65	-.094	.18	-.042	.63
Difficulty	.029	.78	-.469	.01	.266	.01
Retrospective Motivation	.055	.58	.158	.04	.040	.64
Prospective Motivation	-.048	.57	-.055	.42	.055	.50
Mood	.066	.44	-.011	.87	.119	.14
Gender	.224	.08	.054	.39	-.107	.18

Notes. Effects are assessed with the inclusion of covariates described in each study

$R^2$  values: Study 2 = .34; Study 3 = .66; Study 4 = .08

Table 7. Pairwise Correlations from Pilot Study 1

	LI	LTW	TSC	FII	CN	PBC	REL	MPO	ASW
Lay Interactionism	---	---	---	---	---	---	---	---	---
Lay Theory of Willpower	.00	---	---	---	---	---	---	---	---
Trait Self-Control	.11*	-.21**	---	---	---	---	---	---	---
Faith in Intuition	.25**	.07	.08	---	---	---	---	---	---
Connectedness to Nature	.19**	-.19*	.12*	.10 <sup>†</sup>	---	---	---	---	---
Private Body Consciousness	.18**	.08	.01	.36**	.23*	---	---	---	---
Religiosity	.13*	.03	.13*	.02	-.08	-.09	---	---	---
Mental-Physical Overlap	.25**	-.10 <sup>†</sup>	.02	.09 <sup>†</sup>	.13*	.12*	.04	---	---
Academic Contingencies of Self-Worth	.02	.10 <sup>†</sup>	-.11*	.07	-.03	.06	.14**	-.03	---

Note.  $N = 340$ , <sup>†</sup>  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$



Table 8. Effects of LTW, TSC, and MPO in Studies 2-4

	BX	PS	MENT	PHYS	MVP	DIFF	RMOT	PMOT
Study 2	LTW	.11	-.06	.32**	.13	.14	.19*	.04
	Condition x LTW	-.11	.04	-.09	-.20*	-.01	.12	.06
	TSC	-.11	.16 <sup>f</sup>	.01	-.04	-.05	.16 <sup>f</sup>	.15
	Condition x TSC	.14 <sup>f</sup>	-.13	-.04	-.03	-.01	-.08	-.03
	MPO	.00	.10	.11	.04	-.28**	.07	-.04
Study 3	Condition x MPO	.07	.01	-.02	.07	.13	-.03	.01
	LTW	-.12	.06	.21*	.00	-.10	-.06	-.13
	Condition x LTW	.02	-.03	-.09	.08	.11	.10	.05
	TSC	.10	-.06	-.14	-.11	-.05	-.12	-.01
	Condition x TSC	.15	-.27**	.06	-.06	.10	.03	-.05
Study 4	MPO	.08	-.03	.08	.03	.03	.06	.23*
	Condition x MPO	-.20*	.16	-.16	.06	.03	-.01	-.09
	LTW	-.02	---	.15*	-.04	-.10	-.02	.06
	Condition x LTW	.04	---	.06	.06	.05	.15 <sup>f</sup>	.05
	TSC	.13 <sup>f</sup>	---	.03	.15 <sup>f</sup>	.09	-.03	.08
	Condition x TSC	-.09	---	.08	.12	.05	-.03	-.03
	MPO	-.11	---	.13 <sup>f</sup>	.01	-.04	.05	.03
	Condition x MPO	-.02	---	-.11	-.01	.07	-.02	-.01

Notes. Values represent standardized beta weights.

<sup>f</sup>  $p \leq .10$  \*  $p \leq .05$  \*\*  $p \leq .01$ .

LTW = lay theory of willpower, TSC = trait self-control, MPO = mental-physical overlap,

BX = primary behavioral self-control measurement; Study 4 = overall Stroop performance,

PS = pain slope, MENT = mental perceptions, PHYS = physical perceptions, MVP = mental vs. physical,

DIFF = perceived difficulty, RMOT = retrospective motivation, PMOT = prospective motivation

Pain slope was not assessed in Study 4.

Figures

Figure 1. Effect of condition on behavioral metrics of self-control in Study 2 (Panel A), Study 3 (Panel B), and Study 4 (Panel C). Persistence times are measured in seconds.

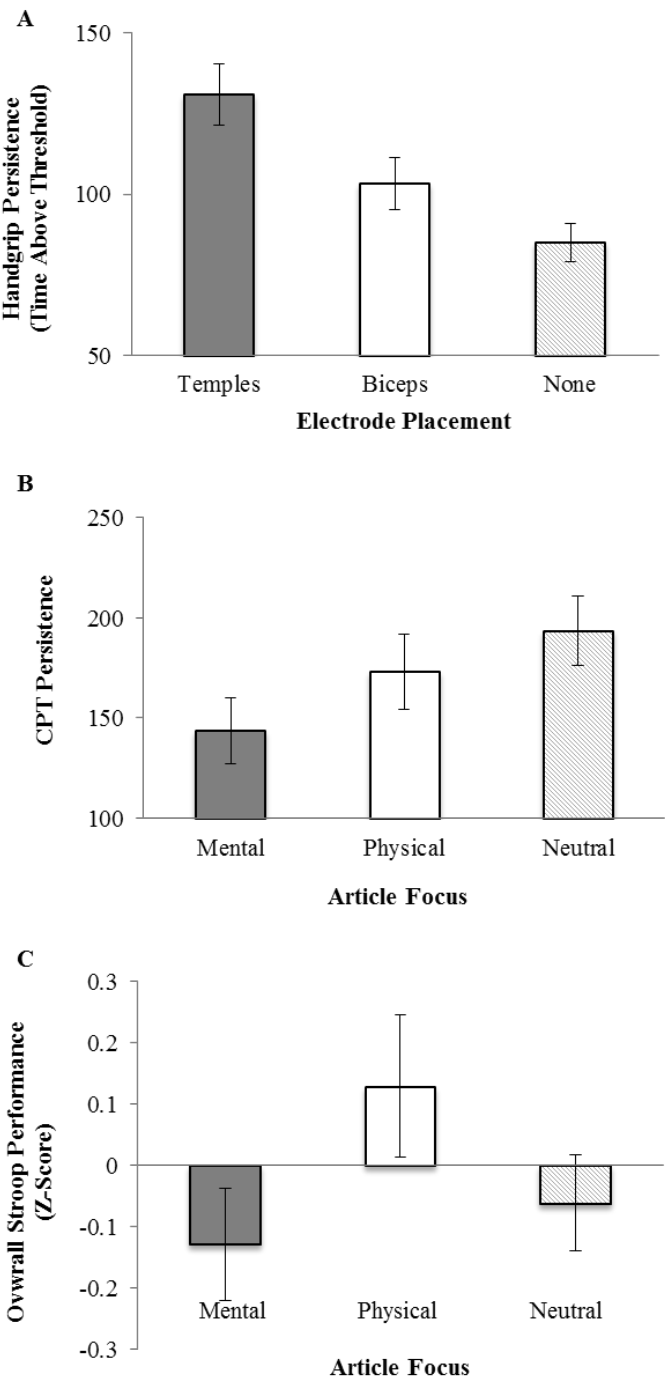
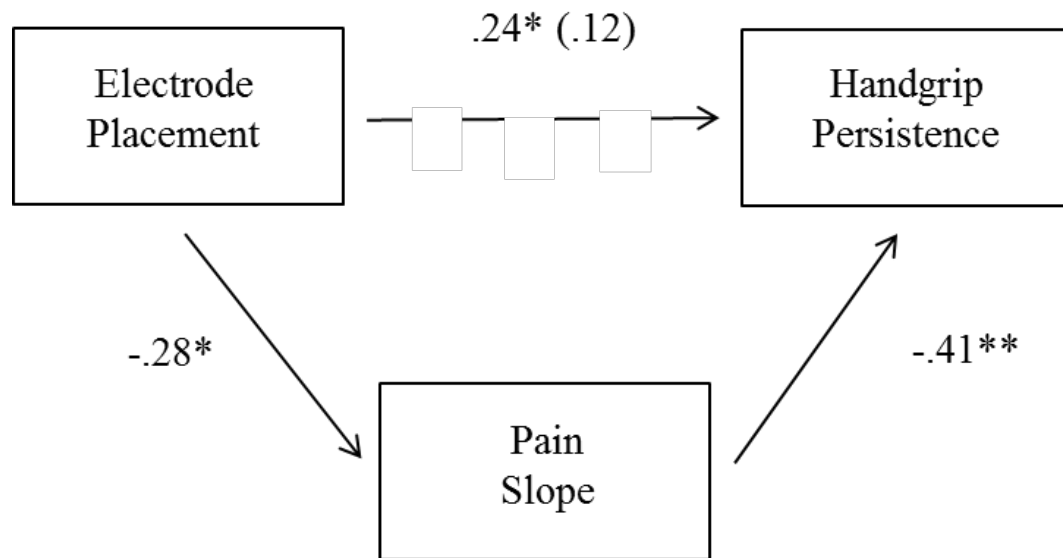


Figure 2. Meditational effect of pain slope on the relationship between experimental condition and handgrip persistence in Study 2.



## **Appendix 1: Pilot Studies**

Below I outline the methodology and primary results of pilot studies that preceded the completion of the studies presented in the main text. In particular, Pilot Study 1 represents a precursor to Study 1, Pilot Study 2 represents a precursor to Study 2, and Pilot Study 3 represents a precursor to Studies 3 and 4.

### **Pilot Study 1: Lay Interactionism Assessment**

#### **Participants/Procedure**

379 participants from Amazon's MTurk were recruited for the present study, each of whom received \$0.50 for participation. 34 participants were removed from the final dataset for failing the attention checks contained within the study (see below), and 5 participants were removed from the final dataset for answering all items with the same response, leaving 340 participants for analysis.

Participants read instructions regarding the purpose of the present study and provided consent electronically. Upon providing consent, they were redirected to a Qualtrics survey that contained a variety of demographic questions (e.g., age, gender, ethnicity, education, SES, nationality, religiosity), several individual difference measures, and a short debriefing. Lay interactionism items were presented before all other individual difference constructs, and the order of these other constructs was randomized across participants. Following the debriefing, participants completed an attention check measurement, and were then given a code to enter into the original study recruitment screen to receive payment for study completion.

#### **Measures**

*Lay Interactionism (LI).* This scale was a slightly altered version of the scale used in the studies presented within the main text ( $\alpha = .68$ ; see Appendix 2).

*All Other Individual Differences.* The item wordings and scales utilized for other individual difference measures, including connectedness to nature (CNS;  $\alpha = .86$ ), faith in intuition (FII;  $\alpha = .82$ ), religiosity (REL;  $\alpha = .95$ ), private body consciousness (PBC;  $\alpha = .62$ ), lay theories of willpower (LTW;  $\alpha = .89$ ), brief self-control (TSC;  $\alpha = .87$ ), academic contingencies of self-worth (CSW;  $\alpha = .79$ ), and mental-physical overlap (MPO) were all identical to those utilized in Study 1 (see Appendix 2).

*Attention Check.* Because attrition/validity concerns are pronounced in Internet sampling (e.g., Crump, McDonnell, & Gureckis, 2013), I included an attention check to identify participants who failed to follow instructions contained within the present protocol. Following the lay interactionism items, participants were provided with a short set of instructions asking them to remember two randomly generated one-digit numbers until the end of the experiment. Participants were informed that they could write these numbers down or simply store them in memory, but that they would be asked to recall both numbers at the end of the study to receive full credit for participation. Although all participants inevitably received credit for completing the experiment, this credit-contingency information attempted to ensure that participants took the attention check seriously. At the end of the study, participants were provided with two text boxes in which they were asked to type in the numbers they were asked to remember. Participants who failed to correctly recall either of these numbers ( $n = 39$ ) were removed from the dataset prior to analysis.

## **Results**

*Reliability.* The assessment of inter-item reliability yielded a moderate value of .68, which is slightly below conventional thresholds for acceptable scalar consistency (i.e., .70). However, because the LI metric approached a reasonable value, the LI items were averaged and subsequently correlated with the other individual difference under study.

*Correlational Analyses.* To assess the extent to which LI correlated with the other individual differences, I computed pairwise correlations of each individual difference and demographic feature with LI. As predicted, there were several robust correlations between LI and the other individual differences of interest. That is, LI was positively related to REL ( $r = .13, p = .01$ ), TSC ( $r = .11, p = .04$ ), CNS ( $r = .19, p < .001$ ), FII ( $r = .25, p < .001$ ), PBC ( $r = .18, p = .001$ ), and MPO ( $r = .25, p < .001$ ). The only individual differences to not significantly covary with LI were LTW ( $r = .00, p = .98$ ) and ASCW ( $r = .06, p = .30$ ).

Interestingly, although LI and MPO showed a strong positive correlation, LI was more predictive of these other individual differences than was MPO, the latter of which did not correlate with REL ( $r = .04, p = .42$ ) or TSC ( $r = .02, p = .66$ ), and correlated comparatively less strongly with CNS ( $r = .13, p = .02$ ), FII ( $r = .09, p = .10$ ) and PBC ( $r = .12, p = .03$ ). In contrast to LI, MPO correlated marginally with LTW ( $r = -.10, p = .07$ ).

## **Pilot Study 2: Electrode Manipulation**

To assess the potential efficacy of the electrode manipulation included within Study 2, a pilot study was employed to assess the extent to which reading about these

electrode attachments would influence participants' perceptions of a hypothetical handgrip task.

### **Participants/Procedure**

145 IU undergraduate participants participated in the present study for partial course credit. Participants were exposed to one of two passages concerning their perceptions of a hypothetical handgrip task using Qualtrics software. After completing a short set of individual difference measures, participants were exposed to the manipulation of the study, which was in the form of a hypothetical task description. In both versions of this description, participants read two paragraphs about a handgrip task that was being conducted within another laboratory at IU, and were provided with information concerning the nature of the task from the participant's perspective (see Appendix 5). However, these versions varied concerning the electrophysiological measurement that was collected concurrently to handgrip performance. That is, in the mental version, participants read that performance on this task would be tracked alongside electrophysiological responses from the temples ( $n = 72$ ), whereas in the physical version, participants read that performance on this task would be tracked alongside electrophysiological responses from the biceps ( $n = 73$ ). After reading the passage, participants completed a series of questions concerning their perceptions of the task described (see below).

### **Measures**

All items were assessed on a scale ranging from 1(*Strongly disagree*) to 7(*Strongly Agree*).

*Lay Interactionism.* Participants completed an assessment of LI at the outset of the study, which was identical to the scale utilized in Study 1 ( $\alpha = .80$ ; see Appendix 2).

*Mental Task Perceptions.* Participants indicated the extent to which they perceived the handgrip task as mental in nature by completing the item “This task requires a lot of mental fortitude”.

*Physical Task Perceptions.* Participants indicated the extent to which they perceived the handgrip task as physical in nature by completing the item “This task requires a lot of physical strength”.

*Anticipated Enjoyment.* Participants indicated the extent to which they anticipated enjoying the handgrip task by completing the item “This task sounds like a fun challenge”.

## **Results/Discussion**

Results showed that participants perceived the task to require marginally more mental fortitude,  $t(143) = -1.37, p = .08$  (one-tailed), as well as marginally less physical strength,  $t(143) = 1.36, p = .09$  (one-tailed), when provided with the temple electrode attachment information, as opposed to the bicep electrode attachment information. While relatively unreliable from a statistical standpoint, these findings nonetheless suggest that thinking about electrode placement during a handgrip task can alter perceptions of the task, such that participants perceive a handgrip task as more mentally involving and less physically involving when thinking about electrodes being placed upon the temples, rather than the biceps. Given the hypothetical nature of this reading task, and thus the relative lack of psychological realism this task provides compared to an in-vivo electrode attachment, such results provided some measure of confidence that the electrode



placement manipulation employed in Study 2 would influence participants' perceptions of the handgrip persistence task.

In addition to the effect of condition on task perceptions, results found no effects of condition on anticipated enjoyment. That is, participants did not anticipate themselves to enjoy the task differentially as a function of experimental condition,  $t(143) = 0.37, p = .71$  (two-tailed). Such findings suggest that even if participants tend to perceive the task differentially as a function of electrode placement (see above), this placement nonetheless does not alter perceptions of anticipated enjoyment.

In addition exploring the effect of condition on perceptual metrics, I also explored the effect of LI on these same metrics. Specifically, I computed correlations between LI and mental task perceptions, physical task perceptions, and anticipated enjoyment. Interestingly, these analyses yielded significant effects. In particular, higher interactionism scores corresponded with greater mental task perceptions ( $r = .25, p = .002$ ), lesser physical task perceptions ( $r = -.26, p = .001$ ), and greater anticipated enjoyment ( $r = .20, p = .02$ ). Such findings provide support for the notion of LI being a critical moderator of perceptual responses under study, such that individual differences in the perceived overlap between mental and physical phenomena led individuals to have differing interpretations an otherwise identical self-control task.

### **Pilot Study 3: Passage Manipulation**

To assess the efficacy of the reading passage manipulation, a pilot study was conducted concerning the extent to which reading this passage affected participants' perceptions of the self-regulatory tasks utilized in Studies 3 and 4.

#### **Participants/Procedure**

174 MTurk participants completed an online survey via Qualtrics software for minor financial compensation. Participants read one of three passages about the challenges of student athletes (i.e., mental or physical; see Appendix 6). Following this, participants answered a series of questions regarding their perceptions of a particular self-control task (cold pressor performance,  $n = 122$ ; Stroop inhibition,  $n = 52$ ). Each participant read only one passage and answered questions concerning only one self-control task. This design was chosen to decrease participant attrition (i.e., MTurk population), as well as to avoid explicit comparisons across multiple self-control tasks (i.e., demand characteristics). Upon completing this self-control passage, participants were asked a short series of questions about task described.

## Measures

All items were assessed on a scale ranging from 1 (*Strongly disagree*) to 7 (*Strongly Agree*). Because the statistical reliability of inter-item relationships varied as a function of task type, each metric contains a different subset of items for the CPT and Stroop tasks.

*Mental Task Perceptions.* Participants indicated the extent to which they perceived the task as mental in nature by completing the three items (“This task requires a lot of mental fortitude”; “This task sounds highly mentally demanding”). Items combined to form a reliable index for both the CPT task ( $r = .51, p < .001$ ) and the Stroop task ( $r = .31, p = .003$ ).

*Physical Task Perceptions.* Participants indicated the extent to which they perceived the task as physical in nature by completing a single item (“This task requires a lot of physical strength”).

*Anticipated Enjoyment.* Participants indicated the extent to which they anticipated enjoying the task by completing two items (“This task sounds like a fun challenge”; “I feel like I could perform at an above-average level on this task”). Items combined to form a reliable index for both the CPT task ( $r = .41, p < .001$ ) and the Stroop task ( $r = .24, p = .03$ ).

## **Results/Discussion**

Task ratings were analyzed using t-test comparisons between conditions. These analyses are grouped by task type below.

*CPT Task.* Results for the CPT sample revealed a significant effect of condition on mental task perceptions ( $t(120) = 2.58, p = .01$ ), a marginal effect of condition on physical task perceptions ( $t(120) = -1.71, p = .09$ ), and no effect of condition on anticipated enjoyment ( $t(120) = -1.22, p = .23$ ). As such, the article manipulation had its intended effect on participants’ perceptions of the CPT’s mental - and to a lesser extent, physical - nature, such that reading about psychological outcomes of student-athletes led participants to more readily perceive the task’s mental nature. However, this manipulation did not affect participants’ anticipated enjoyment of the task, suggesting that its influence was relatively specific to metaphysical perceptions.

*Stroop Task.* Results for the Stroop sample revealed no effects of condition on mental task perceptions ( $t(50) = -0.74, p = .46$ ), physical task perceptions ( $t(50) = -0.49, p = .62$ ), or anticipated enjoyment ( $t(50) = 0.36, p = .72$ ). Thus, in contrast to the findings from the CPT sample, these results suggest little influence of the article manipulation on participants’ perceptions of a relatively cognitive self-control task.

## Appendix 2: Self-Report Measurements

\* : scale ranged from 1(*Strongly disagree*) to 7(*Strongly agree*)

† : scale ranged from 1(*Not at all*) to 9(*Very much*)

χ : scale ranged from 1(*Strongly disagree*) to 7(*Strongly agree*)

R : item was reverse-coded

### Study 1

#### Demographic Questions

1. What is your gender? (Male, Female)
2. What is your ethnicity? (Caucasian, African-American, Latino/a, Native American, Pacific Islander, Other)
3. What is your age?
4. What is your academic major?

#### Lay Interactionism \* ( $\alpha = .80$ )

1. A person's body posture influences their mental state.
2. A person's mind needs regular intellectual exercise to stay fit.
3. Positive thinking can speed up a person's recovery from health problems.
4. A person's thought patterns do not directly affect their susceptibility to disease. (R)
5. Intense mental work does not require as much energy as intense physical work. (R)
6. What someone eats does not influence their intellectual abilities. (R)
7. Eating non-nutritious food can cause lowered mental focus.
8. Experiencing stress and anxiety can directly cause health problems.
9. Mental exhaustion indicates that a person's body needs rest.
10. The mind and body require similar nutrition to perform at a high level.
11. Rigorous physical exercise does not require a strong mental focus. (R)
12. A person's thoughts cannot immediately impact their bodily state. (R)
13. Getting in better shape does not improve a person's intellectual abilities. (R)
14. Physical illnesses are rarely caused by psychological problems. (R)
15. A person's mood "leaks out" through their body language.

#### Lay Theory of Willpower \* ( $\alpha = .88$ )

1. Strenuous mental activity exhausts your resources, which you need to refuel afterwards.
2. After a strenuous mental activity, your energy is depleted and you must rest to get it refueled again.
3. When you have been working on a strenuous mental task, you feel energized and can immediately start another demanding activity. (R)
4. Your mental stamina fuels itself. Even after strenuous mental exertion, you can continue doing more of it. (R)
5. When you have completed a strenuous mental activity, you cannot start another activity immediately with the same concentration because you have to recover your mental energy again.
6. After a strenuous mental activity, you feel energized for further challenging activities. (R)

#### Trait Self-Control \* ( $\alpha = .83$ )

1. I am good at resisting temptations.
2. I have a hard time breaking bad habits.
3. I am pretty lazy. (R)
4. I can often say very inappropriate things. (R)
5. I do certain things that I know are bad for me, if they are fun. (R)
6. I refuse things that are bad for me.
7. I wish I had more self-discipline. (R)

8. People would say that I have really good self-discipline.
9. Pleasure and fun sometimes keep me from getting my work done. (R)
10. I have trouble concentrating. (R)
11. I am able to work effectively towards long-term goals.
12. Sometimes I can't stop myself from doing something, even if I know it is wrong. (R)
13. I often act without thinking through all of the alternatives. (R)

**Self-Control as Energy** \* ( $\alpha = .90$ )

1. After putting my best foot forward, I need to replenish my reserves.
2. After trying to control my emotions, I feel tired.
3. After finishing something I don't like to do, I feel like letting it all hang out.
4. I get tired when I have to control myself.
5. I have difficulties trying to control myself when I am tired.
6. If I try hard my battery runs down; I need a break before I can go on.
7. If I control myself, this costs me a lot of energy.
8. After completing an exacting task, I take some time to relax.
9. Controlling intense emotions wears me out.
10. If I plan to do something that involves self-control, I try to be well-rested.

**Self-Control as State of Mind** \* ( $\alpha = .76$ )

1. I perform better when I am under pressure.
2. I always manage to find the energy for the things I want to do.
3. Sometimes, when I feel like I am finished, I can do a lot more than I thought.
4. If things don't go my way, I add a little extra.
5. If I am really motivated, I always manage to control myself.
6. If you really want to, there are no limits to the extent to which you can control yourself.
7. If I manage to control myself, I feel more energetic.
8. If I feel tired, I try to compensate by trying extra hard.
9. Successful control is a matter of the right mentality.
10. If I control myself, I feel strong.

**Generalized Self-Efficacy** \* ( $\alpha = .92$ )

1. I will be able to achieve most of the goals I have set for myself.
2. When facing difficult tasks, I am certain that I will accomplish them.
3. In general, I think that I can obtain outcomes that are important to me.
4. I believe I can succeed at most any endeavor to which I set my mind.
5. I will be able to successfully overcome many challenges.
6. I am confident that I can perform effectively on many different tasks.
7. Compared to other people, I can do most tasks very well.
8. Even when things are tough, I can perform quite well.

**Free Will Belief** \* ( $\alpha = .87$ )

1. People have complete control of the decisions they make.
2. People must take full responsibility for any bad choices they make.
3. People can overcome any obstacles if they truly want to.
4. Criminals are totally responsible for the bad things they do.
5. People have complete free will.
6. People are always at fault for their bad behavior.
7. Strength of mind can always overcome the body's desires.

**Categorical Thinking** \* ( $\alpha = .66$ )

1. There are basically two kinds of people in this world, good and bad.
2. I think there are many wrong ways, but only one right way, to almost anything.
3. I tend to classify people as either for or against me.

**Faith in Intuition** \* ( $\alpha = .75$ )

1. My initial impressions of people are almost always right.
2. I trust my initial feelings about people.
3. When it comes to trusting people, I can usually rely on my gut feelings.
4. I believe in trusting my hunches.
5. I can usually feel when someone is right or wrong, even if I can't even how I know.
6. I am a very intuitive person.
7. I can typically sense right away if a person is lying.
8. I am quick to form impressions about other people.
9. I believe I can judge character pretty well from a person's appearance.
10. I often have clear visual images of things in my mind.
11. I have a very good sense of rhythm.
12. I am good at visualizing things.

**Connectedness to Nature** \* ( $\alpha = .84$ )

1. I often feel a sense of oneness with the natural world around me.
2. I think of the natural world as a community to which I belong.
3. I recognize and appreciate the intelligence of other living organisms.
4. I often feel disconnected from nature. (R)
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.
6. I often feel a kinship with animals and plants.
7. I feel as though I belong to the Earth as equally as it belongs to me.
8. I have a deep understanding of how my actions affect the natural world.
9. I often feel as though I am part of the web of life.
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.
11. Like a tree can be part of a forest, I feel embedded within the broader natural world.
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature. (R)
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.
14. My personal welfare is independent of the welfare of the natural world. (R)

**Private Body Consciousness** \* ( $\alpha = .56$ )

1. I am sensitive to internal bodily tensions.
2. I know immediately when my mouth or throat gets dry.
3. I can often feel my heart beating.
4. I am quick to sense the hunger contractions of my stomach.
5. I'm very aware of changes in my body temperature.

**Religiosity** \* ( $\alpha = .95$ )

1. In my daily life, I experience the presence of a divine entity (e.g., God).
2. My religious beliefs are what guide my whole approach to life.
3. I try hard to carry my religion over into all other dealings in life.
4. Overall, I would classify myself as a religious person.

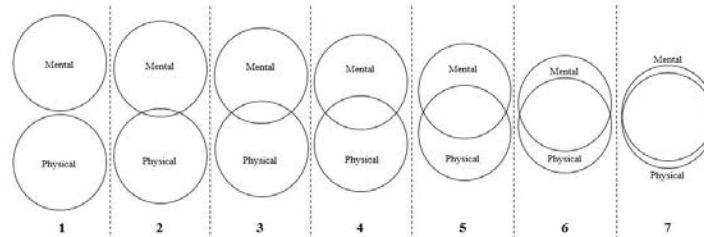
**Mind-Body Dualism** \* ( $\alpha = .79$ )

1. The mind is equivalent to the brain.
2. It is impossible for science to ever have a complete understanding of the mind. (R)
3. One's thoughts, personality, preferences, and choices are all just a product of brain functions.
4. Whether one is a good or bad person can be completely altered by changes in the brain.
5. Aspects of mind that science cannot explain are best explained by the soul. (R)
6. People have a non-physical soul (or spirit) that animates the physical body. (R)
7. A person's soul persists after one dies. (R)
8. Free will is an illusion produced by the brain.
9. The mind interacts with the brain, but is separate from brain. (R)
10. In the future, it may be possible to know someone's personality by looking at their brain activity.
11. The true self is not governed by the brain, but by a person's soul. (R)

12. The mind is a non-physical property. (R)
13. In the future, it may be possible to know exactly what another person is thinking by looking at their brain activity.
14. I believe the mind and soul are the same thing.

### Mental-Physical Overlap

Using the scale below, please indicate (from 1 to 7) your opinion about how much mental and physical processes overlap.



### Perspective-Taking \* ( $\alpha = .71$ )

1. I sometimes find it difficult to see things from another person's point of view. (R)
2. I try to look at everybody's side of a disagreement before I make a decision.
3. I sometimes try to understand my friends better by imagining how things look from their perspective.
4. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments. (R)
5. I believe that there are two sides to every question and try to look at them both.
6. When I'm upset at someone, I usually try to "put myself in their shoes" for a while.
7. Before criticizing somebody, I try to imagine how I would feel if I were in their place.

### Lay Theory of Intelligence \* ( $\alpha = .94$ )

1. You have a certain amount of intelligence, and you can't really do much to change it.
2. Your intelligence is something about you that you can't change very much.
3. No matter who you are, you can significantly change your intelligence level.
4. To be honest, you can't really change how intelligent you are.
5. You can substantially change how intelligent you are. (R)
6. You can learn new things, but you can't really change your basic intelligence.
7. No matter how much intelligence you have, you can always change it quite a bit. (R)
8. You can change even your basic intelligence level considerably. (R)

### Grit \* ( $\alpha = .78$ )

1. I have overcome setbacks to conquer an important challenge.
2. New ideas and projects sometimes distract me from previous ones. (R)
3. My interests change from year to year. (R)
4. Setbacks don't discourage me.
5. I have been obsessed with a certain idea or project for a short time but later lost interest. (R)
6. I am a hard worker.
7. I often set a goal but later choose to pursue a different one. (R)
8. I have difficulty maintaining my focus on projects that take more than a few months to complete. (R)
9. I finish whatever I begin.
10. I have achieved a goal that took years of work.
11. I become interested in new pursuits every few months. (R)
12. I am diligent.

### Academic Contingencies of Self-Worth \* ( $\alpha = .73$ )

1. My opinion about myself isn't tied to how well I do in school. (R)

2. Doing well in school gives me a sense of self-respect.
3. I feel better about myself when I know I'm doing well academically.
4. My self-esteem is influenced by my academic performance.
5. I feel bad about myself whenever my academic performance is lacking.

**Need for Cognition \* ( $\alpha = .91$ )**

1. I would prefer complex to simple problems.
2. I like to have the responsibility of handling a situation that requires a lot of thinking.
3. Thinking is not my idea of fun. (R)
4. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. (R)
5. I try to anticipate and avoid situations where there is likely chance I will have to think in depth about something. (R)
6. I find satisfaction in deliberating hard and for long hours.
7. I only think as hard as I have to. (R)
8. I prefer to think about small, daily projects to long-term ones. (R)
9. I like tasks that require little thought once I've learned them. (R)
10. The idea of relying on thought to make my way to the top appeals to me.
11. I really enjoy a task that involves coming up with new solutions to problems.
12. Learning new ways to think doesn't excite me very much. (R)
13. I prefer my life to be filled with puzzles that I must solve.
14. The notion of thinking abstractly is appealing to me.
15. I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.
16. I feel relief rather than satisfaction after completing a task that required a lot of mental effort. (R)
17. It's enough for me that something gets the job done; I don't care how or why it works. (R)
18. I usually end up deliberating about issues even when they do not affect me personally.

**Need for Closure \* ( $\alpha = .82$ )**

1. I think that having clear rules and order at work is essential for success.
2. Even after I've made up my mind about something, I am always eager to consider a different opinion. (R)
3. I don't like situations that are uncertain.
4. I dislike questions which could be answered in many different ways.
5. I like to have friends who are unpredictable.
6. I find that a well ordered life with regular hours suits my temperament.
7. When dining out, I like to go to places where I have been before so that I know what to expect.
8. I feel uncomfortable when I don't understand the reason why an event occurred in my life.
9. I feel irritated when one person disagrees with what everyone else in a group believes.
10. I hate to change my plans at the last minute.
11. I don't like to go into a situation without knowing what I can expect from it.
12. When I go shopping, I have difficulty deciding exactly what it is that I want. (R)
13. When faced with a problem I usually see the one best solution very quickly.
14. When I am confused about an important issue, I feel very upset.
15. I tend to put off making important decisions until the last possible moment. (R)
16. I usually make important decisions quickly and confidently.
17. I would describe myself as indecisive. (R)
18. I think it is fun to change my plans at the last moment. (R)
19. I enjoy the uncertainty of going into a new situation without knowing what might happen. (R)
20. My personal space is usually messy and disorganized. (R)
21. In most social conflicts, I can easily see which side is right and which is wrong.
22. I tend to struggle with most decisions. (R)
23. I believe that orderliness and organization are among the most important characteristics of a good student.
24. When considering most conflict situations, I can usually see how both sides could be right. (R)
25. I don't like to be with people who are capable of unexpected actions.



26. I prefer to socialize with familiar friends because I know what to expect from them.
27. I think that I would learn best in a class that lacks clearly stated objectives and requirements. (R)
28. When thinking about a problem, I consider as many different opinions on the issue as possible. (R)
29. I like to know what people are thinking all the time.
30. I dislike it when a person's statement could mean many different things.
31. It's annoying to listen to someone who cannot seem to make up his or her mind.
32. I find that establishing a consistent routine enables me to enjoy life more.
33. I enjoy having a clear and structured mode of life.
34. I prefer interacting with people whose opinions are very different from my own. (R)
35. I like to have a place for everything and everything in its place.
36. I feel uncomfortable when someone's meaning or intention is unclear to me.
37. When trying to solve a problem I often see so many possible options that it's confusing. (R)
38. I always see many possible solutions to problems I face. (R)
39. I'd rather know bad news than stay in a state of uncertainty.
40. I do not usually consult many different opinions before forming my own view.
41. I dislike unpredictable situations.
42. I dislike the routine aspects of my studies. (R)

**Private Self-Consciousness \* ( $\alpha = .73$ )**

1. I'm always trying to figure myself out. (R)
2. Generally, I'm not very aware of myself. (R)
3. I reflect about myself a lot.
4. I'm often the subject of my own daydreaming and imaginings.
5. I never scrutinize myself. (R)
6. I'm generally attentive to my inner feelings.
7. I'm constantly examining my own motives.
8. I sometimes have the feeling that I'm off somewhere watching myself.
9. I'm alert to changes in my mood.
10. I'm aware of the way my mind works when I work through a problem.

**Self-Handicapping \* ( $\alpha = .81$ )**

1. When I do something wrong, my first impulse is to blame the circumstances.
2. I tend only to work as hard as I have to in my classes.
3. I tend to put things off to the last moment.
4. It is better to stick to the subjects you're good at, rather than risk looking stupid trying something new.
5. I tend to over-prepare when I have any kind of exam or "performance." (R)
6. People should strive to be the best at whatever they do. (R)
7. I suppose I feel "under the weather" more often than most people.
8. If I do not do well on a test, it just means I have to work harder next time. (R)
9. I always try to do my best, no matter what. (R)
10. I would rather be envied for my ability than appreciated for my hard work.
11. Before I sign up for a course or engage in any important activity, I make sure I have the proper preparation or background.
12. I would be satisfied knowing I had the ability to do something but only lacked the desire to do it.
13. I tend to get anxious before an exam or performance.
14. People who try again after failing are just wasting their time.
15. I am easily distracted by noises or my own creative thoughts when I try to read.
16. Grades should be based in part on how much effort you put into a class. (R)
17. I try not to get too intensely involved in competitive activities so it won't hurt too much if I lose or do poorly.
18. I would rather be respected for doing my best than admired for my potential. (R)
19. Students who keep trying, even in the face of failure, should be admired. (R)
20. I blow things off more than I should.
21. I would do a lot better if I tried harder.
22. I prefer the small pleasures in the present to the larger pleasures in the future.

23. I generally hate to be in any condition but "at my best." (R)
24. Someday I might "get it all together."
25. I sometimes enjoy being mildly ill for a day or two because it takes off the pressure.
26. I would rather be seen as competent than as a hard worker.
27. I would do much better if I did not let my emotions get in the way.
28. In most classes, it is more important to appear intelligent than it is to learn the material.
29. When I do poorly at one kind of thing, I often console myself by remembering I am good at other things.
30. I don't feel sorry for people when they do poorly due to lack of effort. (R)
31. I admit that I am tempted to rationalize when I don't live up to others' expectations.
32. I often think I have more than my share of bad luck in sports, card games, and other measures of talent.
33. People respect ability more than they respect effort.
34. I often think about what it will be like if I do poorly in an academic situation.
35. I would rather not take any drug that interfered with my ability to think clearly and do the right thing. (R)
36. I often try to figure out how likely it is that I will do very well in an academic situation. (R)
37. It is better to be seen as someone with potential than as a person who tried and failed.
38. I overindulge in food and drink more than I should.
39. I often think about what I would do if I did poorly in an academic situation.
40. I have little respect for lazy people. (R)
41. People who do not put forth their best effort are usually more likeable.
42. When something important is coming up, like an exam or job interview, I try to get as much sleep as possible the night before. (R)
43. I admire people who work hard.
44. I never let emotional problems in one part of my life interfere with things in my life. (R)
45. Usually, when I get anxious about doing well, I end up doing better.
46. I usually go into academic situations with positive expectations about how I will do. (R)
47. Sometimes I get so depressed that even easy tasks become difficult.

**Worker Scale \* ( $\alpha = .71$ )**

1. Success due to effort is more meaningful than success due to ability alone.
2. If I don't work my hardest, I feel like I let myself down.
3. I work hard to be successful at whatever I do.
4. I am proud to admit how hard I work to other people.
5. I push myself a lot to perform well academically.
6. I blow things off more than I should.
7. People who procrastinate or do not study adequately for exams have the wrong priorities, even if they can get away with it.
8. I try to devote my full effort to every class I take.
9. I pride myself in being a hard worker.
10. My grades are the result of effort and hard work.

**Self-Esteem \* ( $\alpha = .92$ )**

1. On the whole, I am satisfied with myself.
2. At times, I think I am no good at all. (R)
3. I feel that I have a number of good qualities.
4. I am able to do things as well as most other people.
5. I feel that I do not have much to be proud of. (R)
6. I certainly feel useless at times. (R)
7. I feel that I am a person of worth, at least on an equal basis with others.
8. I wish I could have more respect for myself. (R)
9. All in all, I am inclined to feel that I am a failure. (R)
10. I take a positive attitude towards myself.

**Self-Monitoring \* ( $\alpha = .73$ )**

1. I find it hard to imitate the behavior of other people. (R)
2. My behavior is usually an expression of my true inner feelings, attitudes, and beliefs. (R)
3. At parties and social gatherings, I do not attempt to do or say things that others will like. (R)
4. I can only argue for ideas which I already believe. (R)
5. I can make impromptu speeches even on topics about which I have almost no information.
6. I sometimes put on a show to impress and entertain people.
7. When I am uncertain how to act in a social situation, I look to the behavior of others for cues.
8. I would probably make a good actor.
9. I rarely need the advice of my friends to choose movies, books, or music. (R)
10. I sometimes appear to others to be experiencing deeper emotions than I actually am.
11. I laugh more when I watch a comedy with others than when alone.
12. In a group of people I am rarely the center of attention. (R)
13. In different situations and with different people, I often act like very different persons.
14. I am not particularly good at making other people like me. (R)
15. Even if I am not enjoying myself, I often pretend to be having a good time.
16. I'm not always the person I appear to be.
17. I would not change my opinions (or the way I do things) in order to please someone else or win their favor. (R)
18. I have considered being an entertainer.
19. In order to get along and be liked, I tend to be what people expect me to be rather than anything else.
20. I have never been good at games like charades or improvisational acting. (R)
21. I have trouble changing my behavior to suit different people and different situations. (R)
22. At a party I let others keep the jokes and stories going. (R)
23. I feel a bit awkward in company and do not show up quite as well as I should. (R)
24. I can look anyone in the eye and tell a lie with a straight face (if for a right end).
25. I may deceive people by being friendly when I really dislike them.

**Openness to Experience  $\chi$  ( $\alpha = .70$ )**

1. Is original, comes up with new ideas
2. Is curious about many different things
3. Is ingenious, a deep thinker
4. Has an active imagination
5. Is inventive
6. Values artistic, aesthetic experiences
7. Prefers work that is routine (R)
8. Likes to reflect, play with ideas
9. Has few artistic interests (R)
10. Is sophisticated in art, music, or literature

**Conscientiousness  $\chi$  ( $\alpha = .73$ )**

1. Does a thorough job
2. Can be somewhat careless (R)
3. Is a reliable worker
4. Tends to be disorganized (R)
5. Tends to be lazy (R)
6. Perseveres until the task is finished
7. Does things efficiently
8. Makes plans and follows through with them
9. Is easily distracted (R)

**Extraversion  $\chi$  ( $\alpha = .86$ )**

1. Is talkative
2. Is reserved (R)
3. Is full of energy
4. Generates a lot of enthusiasm

5. Tends to be quiet (R)
6. Has an assertive personality
7. Is sometimes shy, inhibited (R)
8. Is outgoing, sociable

**Agreeableness  $\chi$  ( $\alpha = .83$ )**

1. Tends to find fault with others (R)
2. Is helpful and unselfish with others
3. Starts quarrels with others (R)
4. Has a forgiving nature
5. Is generally trusting
6. Can be cold and aloof (R)
7. Is considerate and kind to almost everyone
8. Is sometimes rude to others (R)
9. Likes to cooperate with others

**Neuroticism  $\chi$  ( $\alpha = .80$ )**

1. Is depressed, blue
2. Is relaxed, handles stress well (R)
3. Can be tense
4. Worries a lot
5. Is emotionally stable, not easily upset (R)
6. Can be moody
7. Remains calm in tense situations (R)
8. Get nervous easily

## **Study 2**

**Demographic Questions** - see Study 1

**Lay Interactionism \*** ( $\alpha = .72$ ) - see Study 1

**Lay Theory of Willpower \*** ( $\alpha = .88$ ) - see Study 1

**Trait Self-Control \*** ( $\alpha = .83$ ) - see Study 1

**Mental-Physical Overlap** - see Study 1

**Mood ( $\alpha = .77$ )**

1. How do you feel right now? - 1(*Very bad*) to 9(*Very good*)
2. How do you feel right now? - 1(*Very positive*) to 9(*Very negative*)
3. How mentally exhausted do you now feel? † (R)
4. How tired do you now feel? † (R)
5. How well can you concentrate right now? †

**Task Difficulty † ( $r = .58$ )**

1. How difficult was it for you to keep your grip maintained throughout the handgrip task?
2. Overall, how difficult did you find the handgrip persistence task to be?

**Mental Task Perceptions † ( $\alpha = .83$ )**

1. How much mental energy did you use when keeping your grip maintained during the task?
2. To what extent do you think the handgrip task is a test of your willpower?
3. In your opinion, how much mental endurance was required to continue succeeding at the handgrip persistence task?
4. To what extent did this task require brain energy to be completed?

**Physical Task Perceptions † ( $\alpha = .72$ )**

1. How much physical energy did you use when keeping your grip maintained during the task?

2. To what extent do you think the handgrip task is a test of your physical abilities?
3. In your opinion, how much muscular endurance was required to continue succeeding at the handgrip persistence task?
4. To what extent did this task require arm energy to be completed?

#### **Mental vs. Physical Task Perceptions**

1. Do you think the handgrip task is more of a mental challenge, or a physical challenge? Please use the scale below to indicate your personal opinion about the task.  
(1 = Primarily Mental, 5 = Equally Mental and Physical, 9 = Primarily Physical)

#### **Retrospective Motivation** † ( $r = .57$ )

1. How motivated were you to put all of your effort into the handgrip task?
2. In all honesty, how much effort did you put into maximizing your performance on the handgrip task?

#### **Prospective Motivation** †

1. How willing would you be to complete another handgrip task later on in this experiment?

#### **Electrode Measure Validity** †

1. How accurate do you believe the electrical measurements taken during this task were?

### **Study 3**

**Demographic Questions** - see Study 1

**Lay Interactionism** \* ( $\alpha = .73$ ) - see Study 1

**Lay Theory of Willpower** \* ( $\alpha = .86$ ) - see Study 1

**Trait Self-Control** \* ( $\alpha = .79$ ) - see Study 1

**Mental-Physical Overlap** - see Study 1

**Mood** ( $\alpha = .73$ ) - see Study 2

#### **Article Perceptions** † ( $\alpha = .93$ )

1. Overall, how interesting did you think this article was?
2. To what extent do you think this article should be included in a future version of the Indiana Daily Student?
3. To what extent do you think this article promotes interesting discussions among IU students?
4. How much would students benefit from reading an article like this in the Indiana Daily Student?
5. How much do you agree with the general opinion of the author in this article?
6. How persuasive was this author?
7. Overall, how effective was the author's writing style in this article?
8. How well organized was the writing in this article?
9. How willing would you be to read other articles by this author in the Indiana Daily Student?

#### **Task Difficulty** †

1. How difficult was it for you to keep your hand submerged in the water during the cold pressor task?

#### **Mental Task Perceptions** † ( $r = .24$ )

1. How much mental strength did you use when keeping your hand submerged during the cold pressor task?
2. To what extent do you think the cold pressor task is a test of your willpower?

#### **Physical Task Perceptions** † ( $r = .51$ )

1. How much physical strength did you use to keep your hand submerged during the cold pressor task?

2. To what extent do you think the cold pressor task is a test of your physical abilities?

**Mental vs. Physical Task Perceptions**

1. Do you think the cold pressor task is more of a mental challenge, or a physical challenge? Please use the scale below to indicate your personal opinion about the task.  
(1 = Primarily Mental, 5 = Equally Mental and Physical, 9 = Primarily Physical)

**Retrospective Motivation †**

1. How motivated were you to put all of your effort into the cold pressor task?

**Prospective Motivation †**

1. How willing would you be to complete another cold pressor task later on in this experiment?

## **Study 4**

**Demographic Questions** - see Study 1

**Lay Interactionism** \* ( $\alpha = .77$ ) - see Study 1

**Lay Theory of Willpower** \* ( $\alpha = .82$ ) - see Study 1

**Brief Self-Control** \* ( $\alpha = .83$ ) - see Study 1

**Mental-Physical Overlap** - see Study 1

**Mood** ( $\alpha = .75$ ) - see Study 2

**Article Perceptions †** ( $\alpha = .94$ ) - see Study 3

**Task Difficulty †** ( $r = .51$ )

1. How difficult was it for you to answer quickly throughout the task?
2. How difficult was it for you to answer accurately throughout the task?

**Mental Task Perceptions †** ( $\alpha = .76$ )

1. How much mental control did you use when maintaining your performance throughout the task?
2. In your opinion, how much mental endurance was required to continue succeeding at the task?
3. To what extent did this task require brain energy to be completed?

**Physical Task Perceptions †** ( $r = .36$ )

1. How much body control did you use when maintaining your performance throughout the task?
2. To what extent do you think the task was a test of your bodily reactions?

**Mental vs. Physical Task Perceptions**

1. Do you think the task is more of a mental challenge, or a physical challenge? Please use the scale below to indicate your personal opinion about the task.  
(1 = Primarily Mental, 5 = Equally Mental and Physical, 9 = Primarily Physical)

**Retrospective Motivation †** ( $r = .71$ )

1. How motivated were you to put all of your effort into the task?
2. In all honesty, how much effort did you put into maximizing your performance on the task?

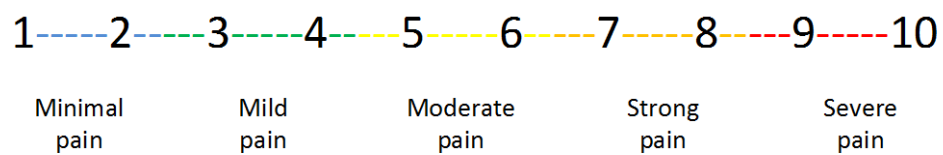
**Prospective Motivation †**

1. How willing would you be to complete another reaction time task like this later on in this experiment?

### Appendix 3: Visual Representations of Methods - Study 2



Pictures show the cubicle in which participants completed the handgrip assessments described in Study 2. The top (bottom) image shows the cubicle prior to (during) the participant's completion of the handgrip persistence task.

**Appendix 4: Pain Scale - Studies 2-3**

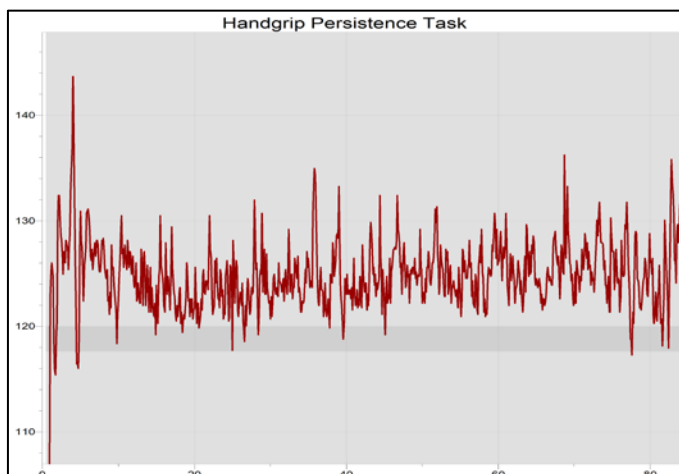


## Appendix 5: Electrode Manipulation Description - Pilot Study 2

### All Conditions

The next task we want you to imagine is what is known as the handgrip persistence task. In this type of task, a participant is brought into the lab to work on a challenging handgrip task. At the outset of the experiment, the participant squeezes an electronic handgrip as hard as they possibly can for about 5 seconds, using their dominant hand. Using the computer program associated with this electronic grip, the experimenter then calculates the participant's maximum force exertion by observing the maximum value obtained during the task. Higher scores indicate a tighter squeeze on the handgrip.

A few minutes after this maximum exertion task, the experimenter gives the participant a different handgrip task, which involves persisting over time (i.e., the handgrip persistence task). Specifically, the participant is asked to maintain 40% of their maximum force on the handgrip for as long as they possibly can. For instance, if the participant's maximum ability on the first task was 300 N (N = Newtons, a measure of force), then the experimenter would set a threshold value of 120 N for the persistence task. The participant's job is to squeeze the grip at a force level that stays above this threshold value (here, 120 N) for as long as they possibly can. In other words, the participant tries to keep the handgrip squeezed just above this threshold level until they can no longer do so. The task is easy at first, but gets progressively harder as time goes by. The experimenter times the participant during this task, and gives them encouragement to keep the handgrip squeezed as the difficulty of the task increases. All the while, the participant's task performance is being tracked visually on the computer (see below).



Example of performance on a handgrip persistence task. Y-axis represents force, X-axis represents time. Participant attempts to maintain performance above dark-gray line until unable to do so.

**Mental Condition**

(After above information)

Before starting the task, the experimenter connects the participant to an EEG (Electroencephalography) machine designed to measure brain activity during the task. To connect the participant to the machine, the experimenter attaches two electrodes to the participant's temples (i.e., 1.5 inches laterally from the outside of each eye), and then places medical tape over the electrodes to ensure that they stay stable for the remainder of the task. The experimenter then turns on the EEG machine, which emits a slight humming noise while it collects electrical activity from the participant's brain. Upon turning on the machine, the participant is asked to start the task, which will continue until their performance drops sufficiently below the threshold value.

**Physical Condition**

(After above information)

Before starting the task, the experimenter connects the participant to an EMG (Electromyography) machine designed to measure muscle activity during the task. To connect the participant to the machine, the experimenter attaches two electrodes to the participant's biceps (i.e., 2 inches above the inside of each elbow), and then places medical tape over the electrodes to ensure that they stay stable for the remainder of the task. The experimenter then turns on the EMG machine, which emits a slight humming noise while it collects electrical activity from the participant's arm. Upon turning on the machine, the participant is asked to start the task, which will continue until their performance drops sufficiently below the threshold value.

**Neutral Condition**

(No additional information)

## Appendix 6: Passage Manipulation - Studies 3-4

### Physical/Mental Condition

#### *The Good, the Bad, and the Ugly: Student-Athlete Lifestyle*

By Cameron Smith - Senior English Major - IU Bloomington

Let's be honest, the life of an IU student-athlete has many advantages. Sweet IU gear for the duration of your academic career, the ability to travel across the country, and the chance to compete for your school at the highest level of collegiate competition. Many of us look on in envy as our favorite student-athletes are able to miss class to play their favorite sport, secretly wishing that we could swap lives with them for just a moment to see what it's like. But is being an IU student-athlete really as glamorous as we sometimes imagine it to be? With this question in mind, I set out to interview several IU student-athletes, to see what it's like to live a day in their shoes.

After talking with many athletes across many sport domains (e.g., basketball, football, soccer, swimming, etc), it became clear to me that the student-athlete lifestyle was not as picturesque as I had always thought. Long hours, grueling practices, nagging injuries, and demanding expectations all come together to make life quite challenging for the average student-athlete. Indeed, while many of them mentioned the benefits associated with their prestigious position on campus (social, educational, and financial), it is clear that these benefits are there to balance out the extreme demands placed upon these dual-tasking students.

For one, these students have incredibly packed schedules during their respective seasons. That is, when they have games to perform in, along with practices to attend, assignments to finish, and a social life to manage, many student-athletes find the time demands quite difficult to adjust to. Waking up at 5 or 6 AM in the morning and going to bed at 10 or 11 PM at night, these students are quite literally running all over campus (and sometimes all over the country) for weeks or months at a time. Needless to say, this kind of schedule takes its *(physical/psychological)* toll. It becomes exceedingly difficult for these students to perform on the field and in the classroom, as their *(bodies/minds)* are perpetually exhausted from requirements of their position. Research shows that long days and limited rest periods can limit an athlete's *(blood glucose levels/intellectual performance)*, and that these deficiencies lead to numerous other *(physical/psychological)* consequences (Long et al., 2011). Further, busy schedules have been shown to increase *(the amount of stress hormones in the body/self-reported stress levels)*, another effect associated with long-term *(physical/psychological)* problems (Primis, Jung, & Walter, 2010).

In addition to the grueling hours and stressful schedules, athletes face many potential injuries, ranging from the minor to the extreme. Even in minor cases, such as when an IU soccer player recalls a small ankle sprain, the effects can be quite serious:

“When I turned my ankle in practice last year, I didn’t think it was going to be a big deal. But when the sprain didn’t get better after a few days, I found myself in a constant state of minor (*pain/fear*), slightly bracing myself when walking around campus or even standing on the sidelines during practice. Although the pain wasn’t unbearable, the constant (*aching/anxiety*) really took a toll on me (*physically/mentally*), and I really struggled to (*exercise/focus*) for a few weeks afterwards. Even when I got back into good shape, my (*technique/mindset*) on the field continued to suffer for a good while.”

This kind of example is commonplace among athletes that I interviewed. Nagging injuries just won’t go away, and the result is an athlete whose (*body/mind*) is never quite at the optimal level. Interestingly, research suggests that chronic (*pain/anxiety*) is yet another way to increase (*the presence of stress hormones in the body/self-reported stress levels*) (Jung, Offen, & Ames, 2011), and that persistent (*pain/anxiety*) can lead to permanent changes in (*blood pressure, heart rate, and overall physical well-being/academic performance, self-control, and overall psychological well-being*) (Herzen, Pokman, Jones, & Fielder, 2013).

It seems obvious that injuries are tough to deal with, and minor injuries are just the beginning. Indeed, it is hard to fathom the (*physical/mental*) difficulties associated with a season-ending, or even career-ending, injury. I spoke with a former IU football player, who told me about his experience (*tearing a major knee ligament/having a concussion*) years ago on an IU practice field:

“I still don’t think my (*body/mind*) has fully recovered from the injury. The (*pain/shock*) was so intense, and the recovery process afterwards was so long. If your (*body/brain*) gets messed up when you’re playing, you have to live with the consequences. I definitely don’t regret playing...I really love the game and still do today. It’s just so tough for your (*body/mind*) to get over an event like that, and it takes so much (*physical/mental*) effort to get anywhere near normal again.”

Although I could go on and on about the difficulties faced by student-athletes, I think the key point I took away from these interviews is that their lifestyle is not nearly as easy or as glamorous as any of us might imagine. With the (*physical/mental*) toll that collegiate athletics takes, in the form of long hours, painful collisions, and grueling training regimens, it is a wonder that they are able to (*energize/motivate*) themselves for another semester at school, let alone another season of athletics. The next time you think about being a student-athlete, remember that the (*physical/psychological*) burdens that they face are a huge part of the reason why they tend to get all those perks.

## **Neutral Condition**

### ***The Good, the Bad, and the Ugly: Student-Athlete Lifestyle***

By Cameron Smith - Senior English Major - IU Bloomington

Let's be honest, the life of an IU student-athlete has many advantages. Sweet IU gear for the duration of your academic career, the ability to travel across the country, and the chance to compete for your school at the highest level of collegiate competition. Many of us look on in envy as our favorite student-athletes are able to miss class to play their favorite sport, secretly wishing that we could swap lives with them for just a moment to see what it's like. But is being an IU student-athlete really as glamorous as we sometimes imagine it to be? With this question in mind, I set out to interview several IU student-athletes, to see what it's like to live a day in their shoes.

After talking with many athletes across many sport domains (e.g., basketball, football, soccer, swimming, etc), it became clear to me that the student-athlete lifestyle was not as picturesque as I had always thought. Long hours, grueling practices, nagging injuries, and demanding expectations all come together to make life quite challenging for the average student-athlete. Indeed, while many of them mentioned the benefits associated with their prestigious position on campus (social, educational, and financial), it is clear that these benefits are there to balance out the extreme demands placed upon these dual-tasking students.

For one, these students have incredibly packed schedules during their respective seasons. That is, when they have games to perform in, along with practices to attend, assignments to finish, and a social life to manage, many student-athletes find the time demands quite difficult to adjust to. Waking up at 5 or 6 AM in the morning and going to bed at 10 or 11 PM at night, these students are quite literally running all over campus (and sometimes all over the country) for weeks or months at a time. Needless to say, this kind of schedule takes its toll. It becomes exceedingly difficult for these students to perform on the field and in the classroom, as they are perpetually exhausted from requirements of their position.

In addition to the grueling hours and stressful schedules, athletes face many potential injuries, ranging from the minor to the extreme. Even in minor cases, such as when an IU soccer player recalls a small ankle sprain, the effects can be quite serious:

“When I turned my ankle in practice last year, I didn't think it was going to be a big deal. But when the sprain didn't get better after a few days, I was slightly bracing myself when walking around campus or even standing on the sidelines during practice. Although the pain wasn't unbearable, it still really took a toll on me, and I really struggled to perform for a few weeks afterwards. Even when I got back into good shape, my performance on the field continued to suffer for a good while.”

This kind of example is commonplace among athletes that I interviewed over the past few months. Nagging injuries just won't go away, and the result is an athlete who is never quite at the optimal level.

It seems obvious that injuries are tough to deal with, and minor injuries are just the beginning. Indeed, it is hard to fathom the difficulties associated with a season-ending, or even career-ending, injury. I spoke with a former IU football player, who told me about his experience years ago on an IU practice field:

“I still don't think I have fully recovered from the injury. It was so intense, and the recovery process afterwards was so long. If you get messed up when you're playing, you have to live with the consequences. I definitely don't regret playing...I really love the game and still do today. It's just so tough to get over an event like that, and it takes so much effort to get anywhere near normal again.”

Although I could go on and on about the difficulties faced by student-athletes, I think the key point I took away from these interviews is that their lifestyle is not nearly as easy or as glamorous as any of us might imagine. With the toll that collegiate athletics takes, in the form of long hours, painful collisions, and grueling training regimens, it is a wonder that they are able to complete another semester at school, let alone another season of athletics. The next time you think about being a student-athlete, remember that the burdens that they face are a huge part of the reason why they tend to get all those perks.

## Appendix 7: Self-Control Task Descriptions - Pilot Study 3

### Cold Pressor Task

One task the kinesiology department uses to measure performance is called a "cold pressor task".

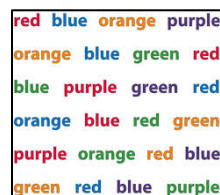
In this task, a participant is asked to submerge their dominant hand in ice-cold water (33 degrees Fahrenheit) all the way up to their elbow. As such, half of their arm is under cold water. The participant's task is to keep their hand and arm submerged in the water for as long as they possibly can. The first few seconds of the task are not too bad, but as the task progresses, the participant is asked to endure increasing levels of pain and difficulty in order to succeed. The experimenter times the participant with a stopwatch during the task, simply measuring how long the participant can endure the cold water before pulling his/her arm out of the water.



### Stroop Task

One task the kinesiology department uses to measure performance is called a "Stroop interference task".

In this task, a participant is asked to respond to by reading the color of the word presented on the screen. In most cases, the color of the font is different than the word on the screen (i.e., the word "RED" presented in green font). As this task continues, the participant has to continue naming the color of the words presented as quickly and accurately as possible. Needless to say, this task becomes more and more difficult over time, as the words and colors keep coming and the participant has to keep up. In a general version of this task, the participant will have to respond to 150-200 words before they are finished. The computer times the participant during the task, while also keeping track of how many errors are made.



## Appendix 8: Exploratory Analyses

Within Studies 2-4, exploratory analyses were conducted concerning the extent to which other individual differences (i.e., lay theory of willpower, trait self-control, mental-physical overlap) predicted the perceptual, cognitive, and behavioral metrics of self-control performance employed in the present work, as well as the extent to which these individual differences interacted with the experimental manipulations under study to predict such metrics. Any significant or marginal effects emerging from these analyses are provided in the subsequent sections below. For reference, all results are listed in Table 7. Unless otherwise noted, results were analyzed via moderated linear regression, using the same covariates reported within the main text.

### Study 2

*Lay Theory of Willpower.* There were several notable effects of LTW within Study 2. For one, there was significant positive effect of LTW on physical task perceptions ( $\beta = .32$ ,  $t(118) = 3.58$ ,  $p < .001$ ), such that individuals who more adamantly endorsed the relative limitations of willpower were more likely to perceive the handgrip task as physically-involving. This effect is potentially attributable to the notion that high LTW individuals perceive self-control as reliant upon physiological resources, and as such, they more readily attend to potential physiological requirements arising during difficult self-regulatory tasks. Second, there was a significant positive effect of LTW on retrospective motivation ( $\beta = .19$ ,  $t(116) = 1.98$ ,  $p = .05$ ), such that endorsing the limitations of willpower was associated with being more motivated to work hard on the handgrip persistence task. One potential explanation for this effect is that high LTW are more likely to experience mental fatigue after the completion of a difficult self-control



task, and this fatigue causes an inference that one was motivated and engaged on the previous task.

Orthogonal to these main effects was a significant condition x LTW interaction on overall task perceptions,  $\beta = -.20$ ,  $t(115) = -2.25$ ,  $p = .03$ . A simple slopes analysis revealed no effect of condition at high ( $\beta = -.14$ ,  $t(116) = -1.16$ ,  $p = .25$ ) or medium ( $\beta = .05$ ,  $t(116) = 0.62$ ,  $p = .53$ ) LTW, and a significant positive effect of condition at low LTW ( $\beta = .25$ ,  $t(116) = 2.11$ ,  $p = .04$ ). This latter finding suggests that lower levels of LTW caused contrast to the experimental condition, such that perceptions of the handgrip task moved in a physical direction as the electrode placement manipulation moved from the biceps to the temples.

*Trait Self-Control.* One particularly notable effect of TSC within Study 2 was a marginally significant condition x TSC on handgrip persistence,  $\beta = .14$ ,  $t(112) = 1.66$ ,  $p = .10$ . Although this interaction was not statistically significant, I nonetheless chose to conduct a simple slopes analysis, which showed a significant positive effect of condition at high TSC ( $\beta = .34$ ,  $t(112) = 2.81$ ,  $p = .01$ ); an effect that was also significant at medium LI ( $\beta = .20$ ,  $t(112) = 2.31$ ,  $p = .02$ ). There was no effect of condition at low TSC ( $\beta = .06$ ,  $t(112) = 0.45$ ,  $p = .66$ ). These simple slope findings indicate that high (and to a lesser extent, medium) self-control individuals were those individuals most likely to show heightened self-control performance as the handgrip task shifted from a physical to a mental framing. One possibility is that, because the handgrip task was more likely to be perceived as a test of self-control when electrodes were attached to the temples, individuals who believed themselves to have high self-control abilities were most likely to benefit from a mental task conceptualization.

In addition to this interactive effect, there were two main effects of TSC on non-behavioral measurements within Study 2. For one, there was a marginal positive effect of TSC on pain slope ( $\beta = .16$ ,  $t(119) = 1.65$ ,  $p = .10$ ), such that individuals who reported higher levels of trait self-control had steeper gains in subjective pain throughout the handgrip task. While this effect is seemingly counterintuitive, one possibility is that reporting a faster onset of pain during the handgrip task allows high TSC individuals to protect themselves against an attribution of poor self-control on the task. In addition, there was a marginal positive effect of TSC on retrospective motivation ( $\beta = .16$ ,  $t(116) = 1.70$ ,  $p = .09$ ), such that high TSC individuals reported having expended somewhat greater effort and energy on the handgrip persistence task than low TSC individuals. From an intuitive standpoint, this effect suggests that participants who perceive themselves to have a greater capacity for self-control report working harder on self-control tasks.

*Mental-Physical Overlap.* There was only one notable effect of MPO within Study 2, which was a significant negative effect on overall task perceptions,  $\beta = -.28$ ,  $t(116) = -3.21$ ,  $p = .002$ . This effect suggests that individuals who were more likely to endorse the overlap between mental and physical phenomena were more likely to perceive that handgrip task in relatively mental (as opposed to physical) terms. This effect conceptually replicates the general effects of LI throughout Studies 2-4.

### **Study 3**

*Lay Theory of Willpower.* The only notable effect of LTW within Study 3 was a significant positive effect on mental task perceptions,  $\beta = .21$ ,  $t(101) = 2.12$ ,  $p = .04$ . This effect simply shows that individuals who believe that willpower is limited (non-limited)

more readily endorsed the mental nature of the CPT task. This perceptual bias can be attributed to high LTW individuals being increasingly sensitive to the influence of mental fatigue, which perhaps causes such individuals to allocate greater attentional and perceptual capacity to the possibility of such fatigue within their general environment.

*Trait Self-Control.* The most notable effect of TSC within Study 3 was a significant condition x TSC interaction on pain slope,  $\beta = -.27$ ,  $t(100) = -2.71$ ,  $p = .01$ . A simple slopes analysis showed a highly marginal negative effect of condition at high TSC ( $\beta = -.21$ ,  $t(100) = -1.57$ ,  $p = .12$ ), no effect of condition at medium TSC ( $\beta = .06$ ,  $t(100) = 0.62$ ,  $p = .54$ ), and a significant positive effect of condition at low TSC ( $\beta = .33$ ,  $t(100) = 2.26$ ,  $p = .03$ ). These simple slope findings suggest that TSC moderated the manner in which the article manipulation impacted subjective pain reporting during the CPT task. At higher levels of TSC, as the article shifted from a physiological to a psychological focus, participants reported less steep pain slopes. In contrast, at lower levels of TSC, as the article shifted from a physiological to a psychological focus, participants reported more steep pain slopes. Put another way, a mentally-focused prime led high TSC individuals to show more effective self-regulation, in the form of less severe gains in pain over time, whereas this same prime led low TSC individuals to show less effective self-regulation. As such, it would appear that focusing on the mental aspects of self-regulation is more (less) beneficial for individuals who perceive themselves to have a strong (weak) capacity for this type of mental exertion.

*Mental-Physical Overlap.* In contrast to the LI data reported within the main text, there was a significant condition x MPO interaction on CPT persistence,  $\beta = -.20$ ,  $t(100) = -1.97$ ,  $p = .05$ . At high levels of MPO, there was a significant negative effect of

condition (high MPO:  $\beta = -.29$ ,  $t(100) = -2.13$ ,  $p = .04$ ). There was no effect of condition at medium ( $\beta = -.11$ ,  $t(100) = -1.07$ ,  $p = .29$ ) and ( $\beta = .08$ ,  $t(100) = 0.58$ ,  $p = .56$ ) low levels of MPO. These simple slope findings suggest that at high levels of MPO, the article manipulation undermined (benefitted) self-control persistence when the writing focused on psychological (physiological) outcomes. Thus, counter to the hypotheses outlined within the main text, perceived overlap between mental and physical phenomena led to greater differentiation between psychological and physiological contextual information, and priming a physiological - rather than psychological - focus led to greater evidence of self-control improvement.

In addition to this interactive effect, there was also a significant positive effect of MPO on prospective motivation,  $\beta = .23$ ,  $t(101) = 2.38$ ,  $p = .02$ . Conceptually replicating the results from Study 4, individuals who more readily endorsed the overlap between physical and mental phenomena were more motivated to complete an additional self-control persistence task later in the experiment. Such results are potentially attributable to the notion that interactionists perceive themselves as able to draw on a broader array of resources (i.e., psychological + physiological) to complete difficult self-regulatory tasks, even when currently experiencing some measure of fatigue.

#### **Study 4**

*Lay Theory of Willpower.* The most notable effect of LTW within Study 4 was a marginal condition x LTW interaction on perceived difficulty,  $\beta = .15$ ,  $t(172) = 1.92$ ,  $p = .06$ . Simple slopes revealed no effect of condition at high ( $\beta = .09$ ,  $t(172) = 0.89$ ,  $p = .38$ ) or medium ( $\beta = -.06$ ,  $t(172) = -0.76$ ,  $p = .45$ ) levels of LTW, and a marginal negative effect of condition at low levels of LTW ( $\beta = -.21$ ,  $t(172) = -1.84$ ,  $p = .07$ ). Such results

suggest that lower levels of LTW caused physical information to heighten perceptions of task difficulty.

In addition to this interactive effect, there was also a significant positive effect of LTW on mental task perceptions,  $\beta = .15$ ,  $t(173) = 2.01$ ,  $p = .05$ . In other words, the more an individual perceived willpower as limited, the more this individual emphasized the mental nature of the Stroop task. From an intuitive standpoint, this effect suggests that high LTW makes individuals more sensitive to the potential mental requirements of self-control tasks; requirements that signal the potential for mental fatigue effects to occur.

*Trait Self-Control.* There were two marginal effects of TSC within Study 4. For one, there was a marginal positive effect of TSC on overall Stroop performance,  $\beta = .13$ ,  $t(173) = -1.67$ ,  $p = .10$ . Consistent with previous research (e.g., Tangney et al., 2004), this effect suggests that high TSC individuals tend to show greater self-regulatory abilities than do their low TSC counterparts. Second, there was a marginal positive effect of TSC on physical task perceptions,  $\beta = .15$ ,  $t(173) = 1.92$ ,  $p = .06$ . That is, participants who reported having a higher ability to exert self-control were increasingly likely to emphasize the physical nature of the Stroop task.

*Mental-Physical Overlap.* There was only one notable effect of MPO within Study 4, which was a marginal positive effect on mental task perceptions,  $\beta = .13$ ,  $t(173) = 1.84$ ,  $p = .07$ . Consistent with the LI results from Studies 2-4, this effect implies that individuals who more readily perceive overlap between physical and mental processes are more likely to emphasize the mental nature of a difficult self-control task.

# Patrick M. Egan

## Curriculum Vitae

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### Education

Southwestern University Graduation: May 2009	B.A. - Psychology	Minor: Sociology	GPA: 3.89
Indiana University Graduation: February 2015	Ph.D. - Social Psychology	Minor: Quantitative	GPA: 3.97

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### Honors & Awards

2014	J.R. Kantor Outstanding Graduate Student Award (\$500)
2014	Gordon Kato Summer Research Scholarship (\$4,000)
2013	Indiana University: Departmental Fellowship (\$23,500)
2011	Society for Personality and Social Psychology: Student Travel Award (\$500)
2010-2013	National Science Foundation: Graduate Research Fellowship (\$30,000)
2009	Indiana University: Departmental Fellowship (\$23,500)
2009	Psi Chi / J.P. Guilford National Paper Competition (\$750)
2008	Southwestern University: Outstanding Achievement in Psychology Award
2008	Mundy Foundation Fellowship: Faculty-Student Collaborative Research (\$1,800)
2007	National Science Foundation Grant: PSLC research program (\$4,000)
2005-2009	Southwestern University: Academic Scholarship (\$8,000)

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### Organizations

2009-present	Society for Personality and Social Psychology: Graduate Student Affiliate
2009-present	Association for Psychological Science: Graduate Student Affiliate
2009-present	Midwestern Psychological Association: Graduate Student Affiliate
2008-2009	Psi Chi Student Treasurer, Southwestern University
2007-2009	Psi Chi National Psychology Honor Society
2007-2009	Southwestern Psychological Association: Student Affiliate
2008-2009	Association for Psychological Science: Student Affiliate
2006-2009	Operation Achievement: Academic Mentor

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### Research Experience

2011-2013	IFLE Graduate Student Mentor for Undergraduate Research
2009-present	Graduate Student – Advisor: Dr. Edward Hirt, Indiana University
2008-2009	Independent Research – Advisor: Dr. Traci Giuliano, Southwestern University

2007-2008      Research Assistant – Advisor: Dr. Traci Giuliano, Southwestern University  
2007              NSF Research Intern – Advisor: Dr. Steve Ritter, Carnegie Learning

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### Teaching Experience

2014              Instructor - Social Psychology, Indiana University  
2013              Graduate Teaching Assistant - Social Psychology, Indiana University  
2013              Instructor - Laboratory in Social Psychology, Indiana University  
2012              Guest Lecturer - Social Cognition, Indiana University  
2012              Instructor - Research Methods in Psychology, Indiana University  
2011              Guest Lecturer - Social Psychology, Indiana University

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### Publications

- Egan, P. M., Clarkson, J. J., & Hirt, E. R. (2015). Revisiting the restorative effects of positive mood: An expectancy-based approach to self-control restoration. *Journal of Experimental Social Psychology, 57*, 87-99.
- Egan, P. M., & Giuliano, T. A. (2009). Unaccommodating attitudes: Perceptions of students as a function of academic accommodation use and test performance. *North American Journal of Psychology, 11*, 487-500.
- Egan, P. M., & Hirt, E. R. (2015). Flipping the switch: Power's cognitive and behavioral effects are moderated by restorative expectancies. *Personality and Social Psychology Bulletin, 41*, 336-350.
- Egan, P. M., Hirt, E. R., & Karpen, S. C. (2012). Taking a fresh perspective: Vicarious restoration as a means of recovering self-control. *Journal of Experimental Social Psychology, 48*, 457-465.
- Howell, J. L., Egan, P. M., Ackley, B. D., & Giuliano, T. A. (2011). The reverse sexual double standard in perceptions of student-teacher relationships: The role of gender, initiator, and power. *Journal of Social Psychology, 151*, 180-200.
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### Manuscripts in Preparation

- Egan, P. M. (in prep). The effects of physical and mental foci on self-regulatory persistence.
- Egan, P. M., Han, D. H., & Hirt, E. R. (under revision). Construal, depletion, and self-control: The role of person-situation fit.
- Egan, P. M., & Hirt, E. R. (in prep). Mastering one's uncertainty: The interaction between goal orientation and uncertainty.
- Egan, P. M., Clarkson, J. J., Hirt, E. R., & Pavlov, O. (in prep). The effect of temporal focus on perceived mental depletion.
- Egan, P. M., Riley, Z., Eckert, N., Hirt, E. R., & Kocejka, D. (in prep). Intensive self-regulation facilitates the onset of muscular fatigue.

Otto, A., Clarkson, J. J., Egan, P. M., & Hirt, E. R. (in prep). The malleable efficacy of willpower theories: A fluency perspective.

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### **Paper Presentations**

Egan, P. M., Clarkson, J. J., & Hirt, E. R. (2012). The role of restorative expectancies in the emergence of spontaneous resource replenishment: A regulatory stimulant hypothesis. Paper presented at the Society for Experimental Social Psychology Conference in Austin (TX), October, 2012.

Egan, P. M., & Hirt, E. R. (2012). How Social Dominance Orientation influences the restorative impact of power. Paper presented at the Midwestern Psychological Association Conference in Chicago (IL), May 2012.

Egan, P. M., Karpen, S. K., & Hirt, E. R. (2011). Vicarious restoration and the moderating impact of target similarity. Paper presented at Social Psychologists of Indiana Conference at Purdue University (IN), April, 2011.

Egan, P. M., Karpen, S. K., & Hirt, E. R. (2011). Taking a refreshed perspective: The vicarious restoration of self-control. Paper presented at the Midwestern Psychological Association Conference in Chicago (IL), May 2011.

Hirt, E. R., Egan, P. M., & Clarkson, J. J. (2012). Spontaneous resource replenishment: On the road to mental recovery. Paper presented at the Midwestern Psychological Association Conference in Chicago (IL), May 2012.

Otto, A.S., Clarkson, J.J., Egan, P.M., & Hirt, E.R. (2014). The malleable efficacy of willpower theories: A fluency perspective. Paper presented at the Midwestern Psychological Association Conference in Chicago (IL), May 2014.

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### **Poster Presentations**

Egan, P. M., & Hirt, E. R. (2014). Lay beliefs concerning the relationship between mental and physical experience. Poster presented at the Society for Personality and Social Psychology Conference in Austin (TX), February 2014.

Egan, P. M., Nagpal, S.\*, & Hirt, E. R. (2013). On the relation between mental and physical fatigue. Poster presented at the Midwestern Psychological Association Conference in Chicago (IL), May 2013.

Egan, P. M., Clarkson, J. J., & Hirt, E. R. (2012). What you perceive is what you get: A process of self-control restoration. Poster presented at the Society for Personality and Social Psychology Conference in San Antonio (TX), January 2011.

Egan, P. M., Clarkson, J. J., & Hirt, E. R. (2011). Spontaneous resource restoration: Uncovering the process from depletion to recovery. Poster presented at the Association for Psychological Science Conference in Boston (MA), May 2010.

Egan, P. M., & Giuliano, T. A. (2009). Unaccommodating attitudes: Effects of accommodations and test performance on perceptions of students. Poster presented at the Association for Psychological Science Conference in San Francisco (CA), May 2009.



- Egan, P. M., Han, D. H., & Hirt, E. R. (2013). Depletion, self-control, and task framing: A construal-matching perspective. Poster presented at the Society for Personality and Social Psychology Conference in New Orleans (LA), January 2013.
- Egan, P. M., & Hirt, E. R. (2010). Master this? The interaction between uncertainty and goal orientation on self-handicapping behavior. Poster presented at the Midwestern Psychological Association Conference in Chicago (IL), May 2010.
- Egan, P. M., Howell, J. L., Ackley, B. D., & Giuliano, T. A. (2008). Moderating factors of the reverse sexual double standard in student-teacher relationships. Poster presented at the Southwestern Psychological Association Conference in San Antonio (TX), April 2008.
- Howell, J. L., Egan, P. M., Ackley, B. D., & Giuliano, T. A. (2009). Scandal in the schoolhouse: Initiation, power, and perceptions of student-teacher relationships. Poster presented at the Association for Psychological Science Conference in San Francisco (CA), May 2009.
- Kim, Y. \*, Egan, P. M., & Hirt, E. R. (2012). Using individual differences to predict lay theories of restoration. Poster presented at the Midwestern Psychological Association Conference in Chicago (IL), May 2012.
- Nagpal, S. \*, Egan, P. M., & Hirt, E. R. (2013). Effects of mental and physical perceptions on self-regulatory tasks. Poster presented at the Social Psychologists of Indiana Conference at Indiana University (IN), April, 2013.
- Otto, A.S., Clarkson, J.J., Egan, P.M., & Hirt, E.R. (2014). Why believing in either more or less willpower capacity can increase self-control performance: A fluency perspective. Poster presented at the Association for Consumer Research Conference in Baltimore (MD), October 2014.
- Pavlov, O. \*, Egan, P. M., & Hirt, E. R. (2013). The effects of temporal focus on perceived ego depletion. Poster presented at the Social Psychologists of Indiana Conference at Indiana University (IN), April, 2013.

\* Denotes undergraduate presenter, mentored by Patrick Egan

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## **Ad Hoc Reviewer**

Journal of Experimental Social Psychology  
 Personality and Social Psychology Bulletin  
 Journal of Social Psychology